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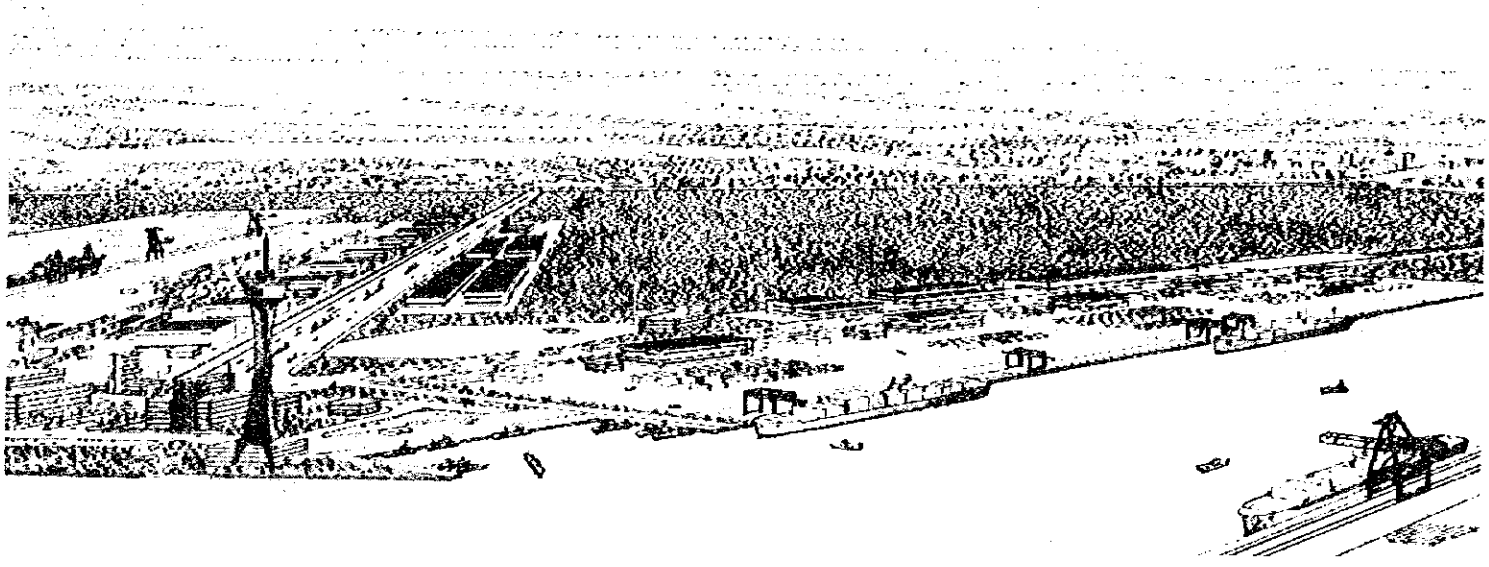
No. 9

THE FEDERAL REPUBLIC OF NIGERIA
REPORT ON
THE NEW OCEAN TERMINAL PROJECT, LAGOS (PHASE-II)

JULY 1980



JAPAN INTERNATIONAL COOPERATION AGENCY

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THE FEDERAL REPUBLIC OF NIGERIA
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PREFACE

With the concurrence of the Government of the Fenderal Republic of Nigeria, the Japanese Government decided to conduct the Phase-II study on the New Ocean Terminal Project and entrusted the Japan International Cooperation Agency (JICA) with the study. The J.I.C.A. sent to Nigeria a study team headed by Mr. Masao Ohno several times from August 1978 to February 1980.

The team exchanged views with the officials concerned of the Government of Nigeria and conducted a field survey in the project area 50 km from the city of Lagos. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of Nigeria for their close cooperation extended to the team.

July 1980

Keisuke Arita

Keisuke Arita
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

Mr. Keisuke Arita, President
Japan International Cooperation Agency

Dear Mr. Arita,

It is my great plesure to submit the report on the study for the New Ocean Terminal Project, Lagos, the Federal Republic of Nigeria.

The Japanese Study Team carried out field surveys in Nigeria from 18-7-78 to 4-8-78, 27-10-78 to 7-11-78, 23-11-78 to 22-12-78, 24-7-79 to 9-8-79, and 3-2-80 to 16-2-80, at the request of the Japan International Cooperation Agency. Following the Phase-I study completed in June 1978, this report was formulated as the Master Plan. It included additional surveys and studies in 1978 and 1979.

The Nigerian Ports Authority has expressed its desire that the Feasibility Study of this project be expedited, due to the vital importance of the project for the development of the Nigerian economy.

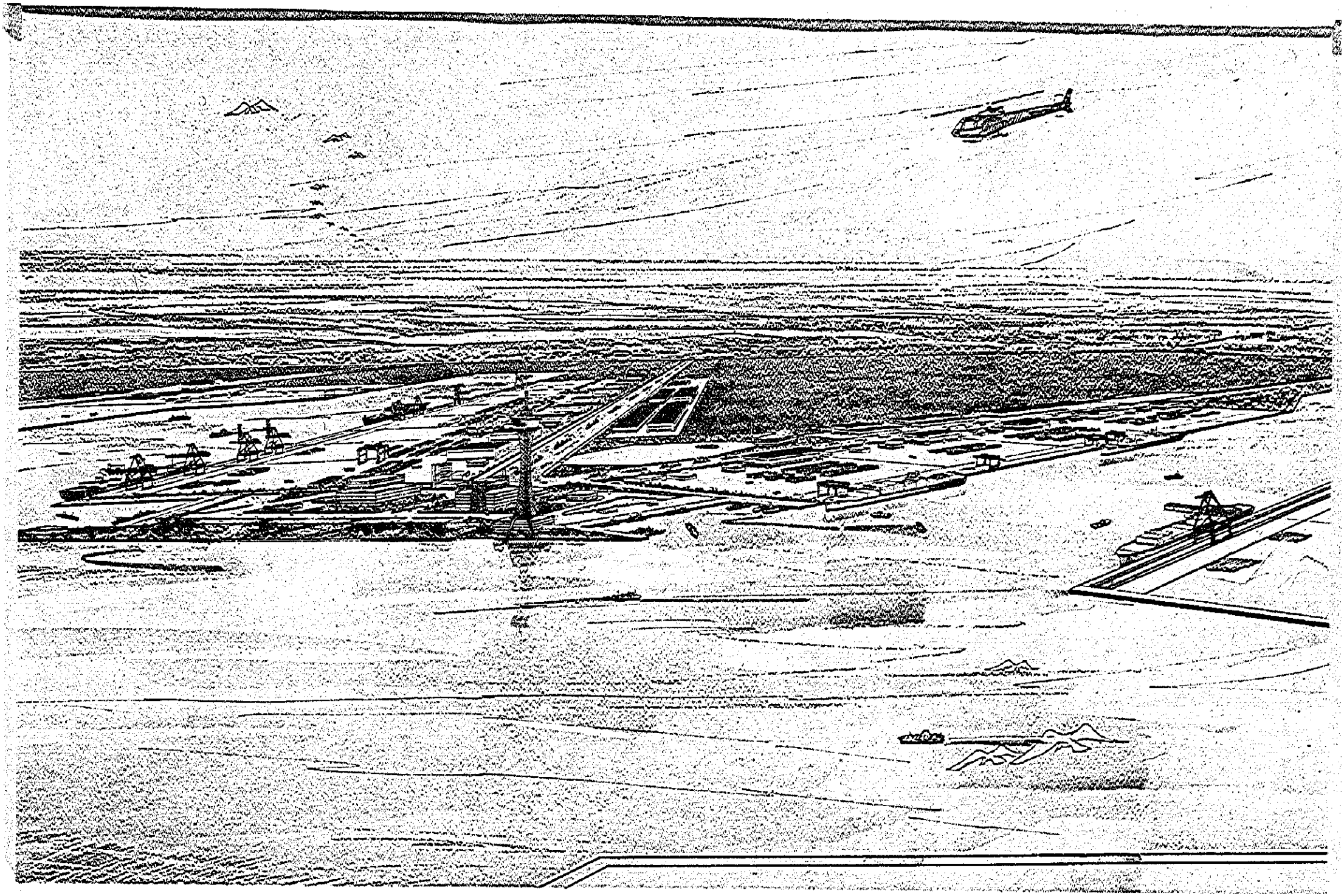
On behalf of the Japanese Study Team, I would like to express my deep appreciation to the Government of the Federal Republic of Nigeria, the Nigerian Ports Authority and the participating government organizations for their unlimited cooperation and assistance. The team members are very grateful for the warm hospitality extended to them during their stay in Nigeria.

I am also indebted to the Japan International Cooperation Agency, the Ministry of Transport, the Ministry of Foreign Affairs, the Japanese Embassy in Lagos, the consultants whom surveyed the site conditions and the many Japanese companies having branches in Lagos, for giving us vaulable suggestions and assistance in the field study and in the preparation of this report.

Sincerely yours,

July 1, 1980

Masao Ohno, Head
Japanese Study Team for the New
Ocean Terminal Project, Lagos
(Executive Director, the Overseas
Coastal Area Development Institute
of Japan)

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C A M E R O U N

Summary of Study Results

SUMMARY OF STUDY RESULTS

CONTENTS

1. Purpose and Scope of the Study in the Fiscal Year 1978 and 1979

In accordance with the Scope of Work agreed upon by the two countries in 1978, three surveys were conducted in 1978: 1) survey concerning the master plan; 2) survey of topographic condition; and 3) geological survey.

The draft report of the Phase-II study, which was formulated on the basis of the results of the Phase-I Report in 1978 and the above surveys, was submitted to the Nigerian Ports Authority in July 1979.

In the fiscal year 1979, as the Phase-II (2nd year) study, survey of natural conditions at the proposed construction site was carried out. On the base of the survey, layout of breakwaters, calmness of the harbour and counter erosion measures etc. were reviewed. Also, forcasts of cargo traffic was modified. In January 1980, the final draft report of the Phase-II study was formulated and submitted to the Nigerian Ports Authority.

This is a final report of Phase-II study, was formulated on the review of the all items of the final draft report and some additional explanations.

The purpose of the master plan is to give a direction to the project from a wider perspective and to ascertain basic facts of the project such as the location and scale of the proposed New Ocean Terminal under long-term objectives. (Basic concept of the development of the New Ocean Terminal has been discussed in Phase-I Report)

Accordingly, the main items of the master plan study are related to comprehensive land use planning of the proposed development area, including general layout of port and harbour facilities such as breakwaters, channels, berths and wharfs which form the framework of the development project, layout of each seaboard industry and that of various urban facilities and transport facilities for trunk routes. They also include preliminary estimate of construction costs of basic facilities and qualitative study of the effects of the development.

As the scale and function of the proposed New Ocean Terminal is considerably large and comprehensive, it will have a wide range of influence on the socio-economic activities and ecological conditions of the surroundings.

The masterplan proposed in this report does not aim at the final conclusion for the New Ocean Terminal project and, as a matter of course, it cannot be said that the report covers all fields of the matter concerned completely.

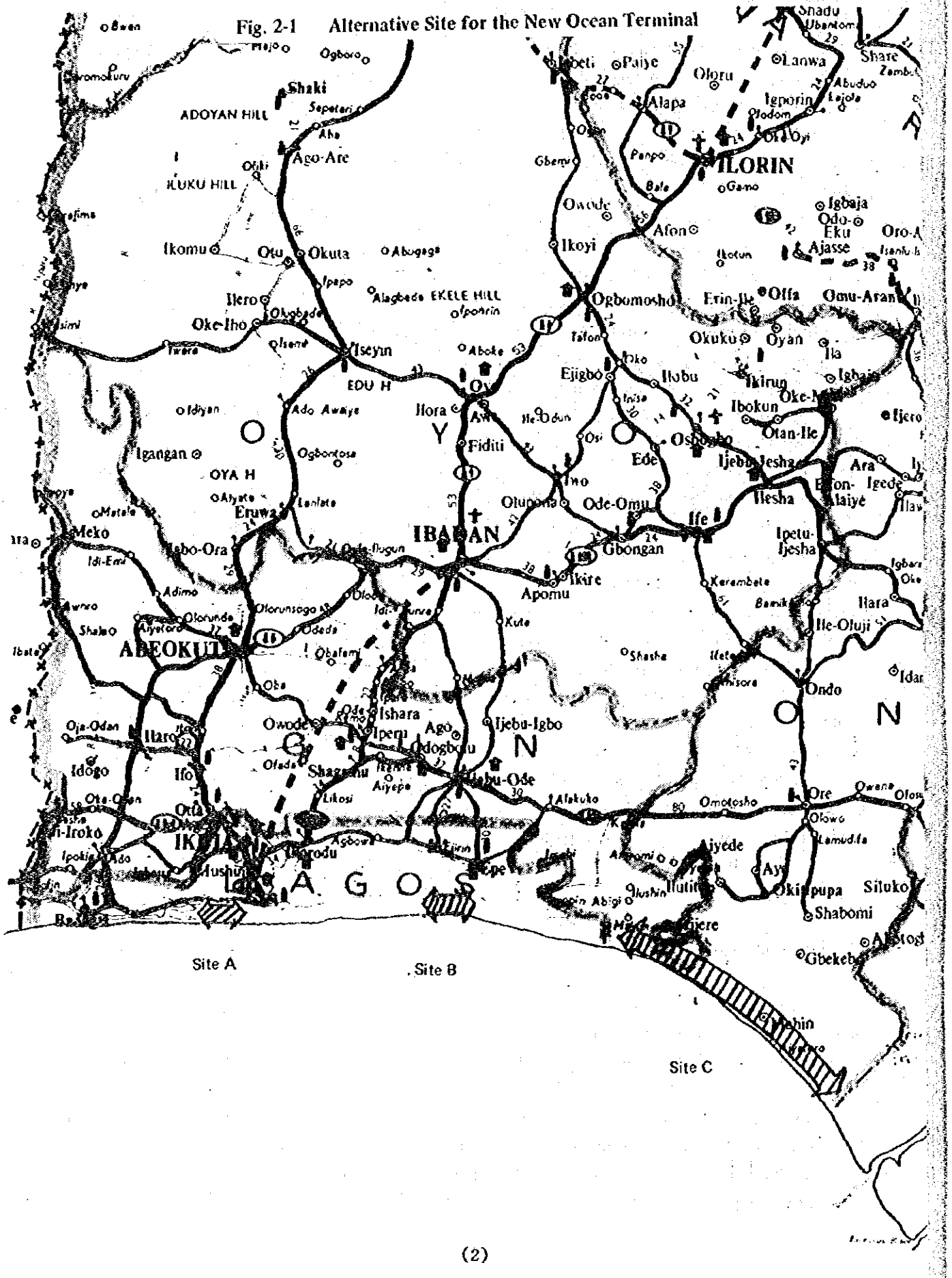
It should be considered as a springboard for further discussions in order to make better decision.

2. Location of the New Ocean Terminal

Comparative studies on the site selection have been made in the Phase-I Report although those are not quantitative but qualitative. As a result the site situated 50km east to Lagos has been selected and the Nigerian Ports Authority has agreed to our selection and to conduct further studies on the proposed site in the fiscal year 1978.

However, opinions were heard, on several occasions when the Team visited Nigeria in November 1978, at the meetings with the Federal Ministry of Transport and Master Plan Project Unit of the Lagos State, that further development of Lagos State should be avoided from a viewpoint of national security or to curb more concentration to the Lagos Metropolitan area and

Fig. 2-1 Alternative Site for the New Ocean Terminal



that an alternative site should be selected with a study either to the entire Nigerian coast-line or to a place further east outside Lagos State. It appears to us that these opinions have overlooked the importance of port in the Lagos metropolitan area and of the metropolitan area itself.

The share of Lagos State will decrease in terms of industrial outputs in future as the development of other regions will be promoted as a result of the Federal Government's policy of industrial dispersal. In our view, however, the economic development of Lagos State cannot cease. An increasing population must be given employment opportunities and better living conditions. Without economic development of Lagos State how could these be realized? As far as the economic development continues and the population increase is inevitable, various types of infrastructures must be improved and expanded in order to attain an orderly development of the Metropolitan area. A commercial port is of a vital importance to the economic development. Is it economical to carry millions of tons of imported commodities from Onne port or Warri to Lagos area by road?

According to the estimate of future traffic, a huge amount of traffic must be handled at the Lagos Ports Complex even if a reduction of share is planned. And furthermore a considerable part of the traffic moves between the port and the Lagos Metropolitan area.

For these reasons it should be understood that the New Ocean Terminal Project is intended for the development of the Lagos Ports Complex and that the site of the New Ocean Terminal must be as close to the centre of the Lagos Metropolitan area as possible with a view to an orderly development of the metropolitan area on a long-term basis.

In case that an industrially less developed nation is going to promote economic development by introducing modern industries, the utmost importance must be placed on offering an attractive site to industries. The nearness to Lagos, the largest domestic market and the existence of a modern seaport are decisively advantageous conditions to industrial locations. It appears to us that at the beginning stage of economic development it is extremely important to develop first the most effective area to the entire economy of a nation.

In order to clarify the justification of the selection of the site for the New Ocean Terminal which has so far been given, overall comparison of three alternative sites, e.g., Site-A (close to the west side of the present Port of Lagos), Site-B (50km east of Lagos) and Site-C (further to the east of Site-B) will be made below from the viewpoint of the suitability for meeting the basic needs of Nigeria (see Table 2-1).

Table 2-1 shows some of the basic needs of Nigeria which may be met with large scale port and harbour development and basic tasks required for that purpose, and Table 2-2 gives qualitative evaluation of the suitability of each site for carrying out the tasks.

In conclusion, after evaluationg the suitability of three alternative sites from various viewpoints, Site-B is, in our opinion, the most suitable site in view of the present situation in Nigeria and topographic and other conditions.

Table 2-1 Evaluation Factors of the Alternatives

Basic needs	Tasks to meet the basic needs
1) Expansion of physical distribution function in Nigeria and the Lagos Metropolitan area.	1) Development of a modern commercial port in the environs of Lagos having the same functions as those of the present Port of Lagos.
2) Development of Nigerian industry.	2) Creation of the basis of industrial development.
3) Sound development of the Lagos Metropolitan area.	3) Dispersion of population and urban functions.

Table 2-2 Evaluation of the Alternative Sites

	Tasks to meet the basic needs		
Site	1) Development of a modern commercial port in the environs of Lagos having the same functions as those of the present Port of Lagos.	2) Creation of the basis of industrial development.	3) Dispersion of population and urban functions.
Site–A	Δ	Δ	X
Site–B	O	O	O
Site–C	X	O	O

Remarks: O Suitable
Δ Not impossible, but technical difficulties.
X Unsuitable

3. Basic Concept for Layout of Various Functions of the New Ocean Terminal and the Scale of Development

3-1. Principles for the formulation of the master plan

The master plan for the New Ocean Terminal is to be formulated according to the basic policy described below.

1) In view of the topographic and natural conditions of the construction site of the New Ocean Terminal, port facilities are to be positioned along excavated channels. In other words, as a basic type, an artificially excavated port is to be selected for the New Ocean Terminal. Further, in order to provide various functions required by the terminal, the port is to have one harbour entrance, and three channels branching off from there.

2) The development of the industrial area is not particularly aimed at the completion in the year 2000; it is more for the provision of space for future location of industries.

The progress of industrial location depends on the policy for industrialization to be taken

by the Federal Government, and it may not coincide with the progress in the development of the commercial port. Therefore, various functions are to be positioned in a way that the development of the commercial port can proceed independently of industrial development. That is, most of the commercial port facilities are to be placed to the west of the main channel and the industrial area to the east.

3) Facilities are to be located in such a way that the development of commercial and industrial port facilities may proceed under stage planning.

4) In view of the predominant wind direction, urban facilities are to be placed in the north of the commercial port area.

5) The arterial road is to run north from the development area to reach the existing road between Epe and Ikorodu via a bridge on the channel linking the Lagos Lagoon and the Lekki Lagoon.

The New City, commercial port area and industrial area are to be linked by arterial roads running through the development area.

6) The new railway line is to be planned basically in the same way as the arterial roads. The time of its construction is, however, to be determined taking account of the time of implementation of the standard gauge project now under study by the Nigerian National Railways.

7) Judging from the data obtained so far, predominant waves are expected to be from SW direction. The main breakwater is, therefore, to be placed to protect the channel and the harbour basin from these waves.

8) As the annual total of incoming vessels is expected to be around 6,000 to 7,000 (average, 17–20 vessels per day), on the final stage of the project with the completion of various plans including industrial development, the port is to adopt the one harbour entrance system.

9) The length of the main breakwater is to be determined so as to ensure safe navigation of the largest ship and calmness of harbour basin. However, it is to be reexamined from the viewpoint of preventing silting of the channel due to littoral drift based on the results of coastal engineering survey in 1979.

10) The width of the entrance channel and the inner harbour channels is to be determined so as to ensure two way traffic as a rule.

11) Space for future expansion of commercial port facilities is to be provided at the end of West, North and East Channels.

3-2. Alternative plans for the layout of functions.

If a long breakwater is allowed to protrude from the sandy shore on a straight line since the littoral current is predominant from west to east, the west side shore of the breakwater is expected to move forward and some part of east side of it may recede as seen near the harbour entrance of Lagos.

Accordingly, an opinion may be heard that it is desirable to place the commercial port area to the east of the main channel and the industrial port area to the west. However, we did not adopt this alternative plan because of the reasons given below.

1) As has been mentioned, the development of the commercial port area is expected to precede industrial development. Therefore, it is desirable that the New City and the commercial port area

are adjacent to each other.

2) Several villages along the coast will be compelled to move by the development of the industrial area. In that case, it is desirable that they move to the coast under aggrandizing condition (west coast) rather than to the one under eroding condition. It will also have the advantage of being nearer to the New City.

3) With the construction of the breakwater, it is conceivable that the coast to the east recedes. However, it is expected that the erosion occurs near the east end of the proposed industrial land or even further to the east. Further, even if the coast fronting the industrial land suffers from erosion, adequate prevention will be possible with the construction of the groin systems and others.

3-3. Alternative plans for the layout of channels and mooring basins.

The one harbour entrance system proposed under the master plan has demerits such as 1) traffic capacity of the entrance section restricts the expansion of the scale of the whole and 2) shipping accident may block the entrance and the port may, as a result, stop functioning.

However, the present project is an extremely long-term plan looking ahead into the future more than 20 years from now, and it is not necessary to consider further development at the same site. For industrial development, for instance, the scale of iron and steel and oil refinery, which form the nucleus, is designed at a standard which compares favorably with the international standard. Further, it is not necessary to carry out further expansion at one and the same site; industrialization in many other areas will in fact be more effective for regional development.

As for the prevention of shipping accidents, it will be possible to reduce the probability greatly by adopting a navigation control system employing electronic equipment and devices.

Accordingly, though the alternative plan of providing two harbour entrances was studied, it was decided not to adopt the plan as the costs of breakwaters, dredging of channels and excavation would increase.

3-4. The master plan and the scale of development

Figs. 3-1; 3-2 and Tables 3-1; 3-2 show the master plan formulated under the above principles and various studies described in the following sections.

Table 3-1(a) Distribution of Land Use in the Development Area

Unit: ha

	1990		2000	
		(%)		(%)
Port & Harbour Area (Land)	293	1	973	5
(Water)	195	1	927	5
Industrial Area	0	0	2,340	12
New City Area	100	1	2,900	14
Arterial Transportation Facility Sites	114	1	225	1
Sub Total	702	4	7,365	37
Reserved Area for Expansion	12,323	61	5,660	28
Unurbanized Area*	7,115	35	7,115	35
Sub Total	19,438	96	12,775	63
Total	20,140	100	20,140	100

Note: * This area includes inland water surface of Omu Creek and Lagos Lagoon.

Table 3-1(b) Port and Harbour Area

Unit: ha

	1990		2000	
		(%)		(%)
Wharf				
Break Bulk (General Cargo) Berths	22	7	122	13
Container Berths	72	25	324	33
Grain Berth	9	3	9	1
Petroleum Oil Berths	35	12	90	9
Small Craft Berths	2	1	3	0
Wharf Total	140	48	548	56
Port Related Commerce & Business	56	19	230	24
Port Roads	57	19	155	16
Other Related Facilities	40	14	40	4
Land Area Total	293	100	973	100
Channel				
Entrance Channel	19	10	196	21
Central Channel	56	29	96	10
West Channel	63	32	152	16
East Channel	–	–	168	18
North Channel	–	–	108	12
Channel Total	138	71	720	77
Water Surface for Basin and so forth	57	29	207	23
Water Area Total	195	100	927	100

Table 3-1(c) Industrial Area

Unit: ha

	1990		2000	
Iron and Steel	–	– (%)	700	30 (%)
Petroleum refining	–	–	300	13
Petrochemicals	–	–	210	9
Chemical Fertilizer	–	–	15	1
Automobile Assembly	–	–	120	5
Shipbuilding & Repair	–	–	45	2
Flour Mill & Food Processing	–	–	15	1
Vegetable Oil	–	–	5	0
Power Station*	–	–	–	–
Other Related Industries	–	–	380	16
Public Facilities	–	–	550	23
Total	–	–	2,340	100

Note: * Power station (40 ha) is planned in the commercial port area.

Table 3-1(d) New City Area

Unit: ha

	1990		2000	
		(%)		(%)
Residential Area	50	50	1,450	50
Commerce & Office	4	4	120	4
Public Facilities	6	6	170	6
Roads	20	20	580	20
Open Space	20	20	580	20
Total	100	100	2,900	100

Table 3-2 Comprehensive Development Frame of the New Ocean Terminal

	1990			2000		
PORT DEVELOPMENT	Cargo Traffic (1,000 ton/yr.)	Berths (No.)		Cargo Traffic (1,000 ton/yr.)	Berths (No.)	
Commercial Port						
Break Bulk General Cargo Berths	1,207	6		6,606	33	
Container Berths	3,006	6		13,414	27	
Grain Berth	964	1		1,042	1	
Petroleum oil Berths	2,100	2		5,400	3	
Small Craft Berths	–	Total length 300 m		–	Total length 1,100 m	
Total	7,277	15	Employees: 2,000 persons, Total Length of: 4,450 m Breakwaters	26,462	64	Employees: 20,000 persons, Total Length of: 5,150 m Breakwaters
Industrial Port						
Iron & Steel Berths	–	–		* (12,900 1,620	(4 9	
Petroleum Oil Berths	–	–		* (18,850 7,160	(2 1	
Petrochemical Berths	–	–		* (150 965	(1 5	
Shipbuilding & repair Berths	–	–		–	3	
Grain Berths	–	–		* (750 0	(1 0	
Total	–	–		42,395	26	

INDUSTRIAL DEVELOPMENT	Production Scale	Employees (person)	Production Scale	Employees (person)
Iron and Steel	–	–	(crude steel) 6 million tons/yr.	10,000
Petroleum refining	–	–	400,000 barrels/day	1,200
Petrochemicals	–	–	(ethylene basis) 400,000 tons/yr.	2,350
Chemical Fertilizer	–	–	500,000 tons/yr.	200
Automobile Assembly	–	–	200,000 vehicles/yr.	5,000
Shipbuilding & repair	–	–	200,000 G.T. dock	1,000
Flour mill & Food Processing	–	–	500,000 tons/yr.	1,300
Vegetable oil	–	–	250,000 tons/yr.	200
Power Station	500,000 KW	150	1 million KW	250
Other Related Industries	–	–	–	8,000
Total	–	150	–	30,000

NEW CITY DEVELOPMENT	Population (person)	Housing (unit)	Population (person)	Housing (unit)
	7,500	1,500	200,000	40,000

Note: * Upper figures show raw materials, lower figures show products.

Fig. 3-1 Master Plan of the New Ocean Terminal in the Year 2000

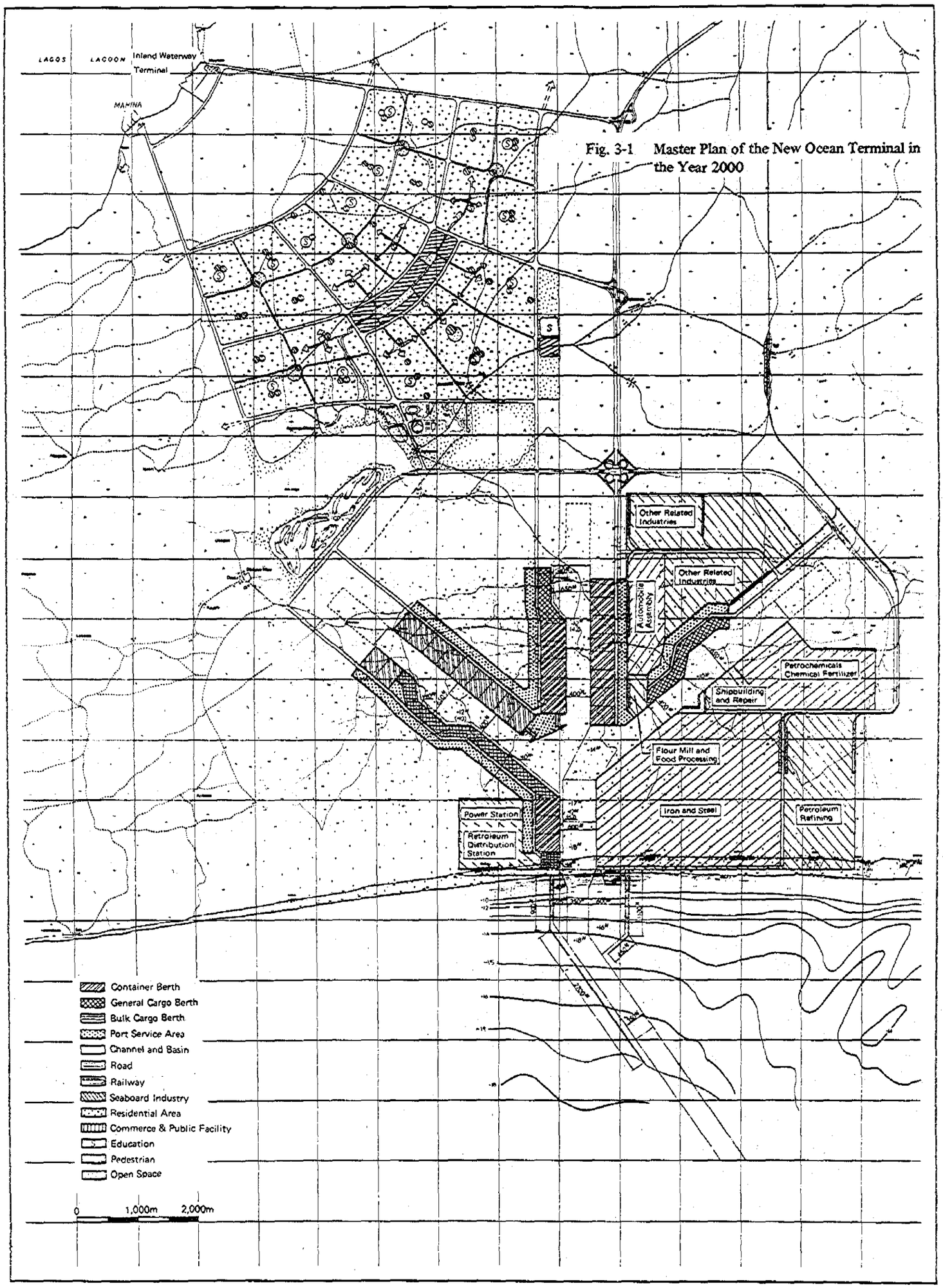
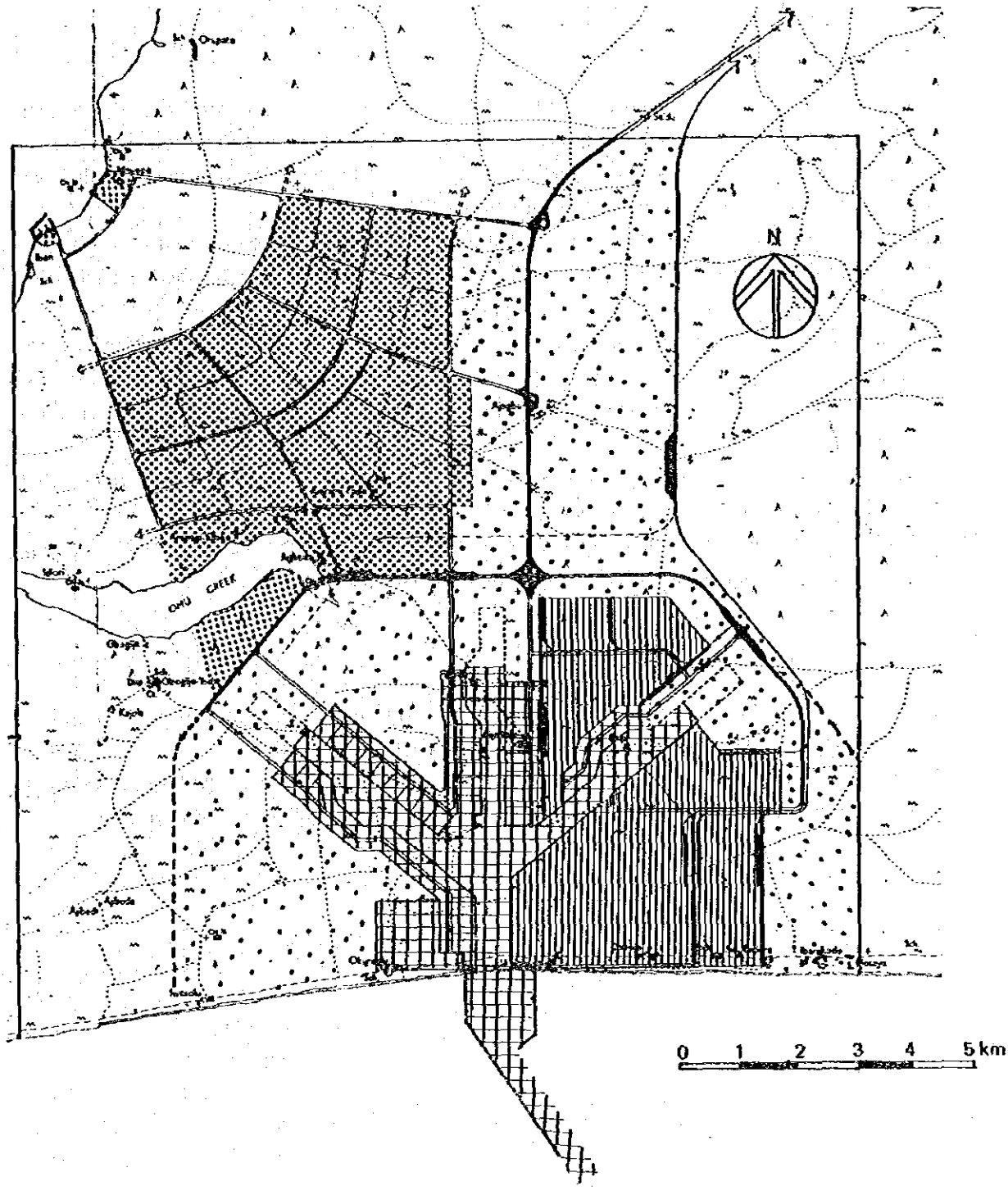


Fig. 3-2 Generalized Land Use Plan in the Development Area



Port and Harbour Area

Industrial Area

New Town Area

Arterial Transportation Facility

Reserved Area for Expansion

Unurbanized Area

4. Scale and Layout of the Commercial Port Facilities

4-1. Principles

Based on the concept of layout employed for the various functions of the New Ocean Terminal described under Chapter 3, layout of the commercial port facilities (container berths, break bulk general cargo berths, grain berths, petroleum oil berths and small craft berths) was determined on the basis of the principles given below.

1) For efficiency in the use of wharfs, mooring facilities are to be of the marginal type.

2) For the economy in the dredging of channels in the harbour, deep water facilities are to be placed near the harbour entrance and relatively shallow water facilities at the inner part.

3) In view of the divisional development, those facilities necessary for the initial stage are not to be dispersed.

4) Berths for crude oil and petroleum products are to be placed near the harbour entrance for safety reasons.

5) Some of the commercial port facilities are to be placed in the industrial port area so that industrial goods for distribution may be handled.

6) Two basins for small craft such as tugboats and harbour launches are to be provided; one in the commercial port area and the other in the industrial port area.

4-2. Number of berths required for the commercial port

Table 4-1 shows the estimated cargo volume, the total number and length of berths required in the year 2000 at the existing Port of Lagos and the New Ocean Terminal.

All in all, a total of 64 berths will be required in the year 2000 at the New Ocean Terminal, allocating 33 to break bulk cargo, 27 to containers, 1 to grain and 3 to petroleum products.

Table 4-1 Commercial Cargo Traffic and Berthing Facilities at Lagos Ports Complex in the year 2000

Ports	Cargo Traffic and Dimension of Berthing Facilities	General Cargo			Grain	Petro-leum Oil	Total
		Break Bulk	Contain-erized	Sub Total			
Lagos Ports Complex (Existing Lagos Port and New Ocean Terminal)	Cargo Traffic (1,000 ton)	11,186	16,814	28,000	1,042	9,400	38,442
	Number of Berths	54*	35	89	1	5	95
	Total Length of Berths (m)	13,705**	10,100	23,805	300	980	25,085
Existing Lagos Port (including the Third Apapa Extension)	Cargo Traffic (1,000 ton)	4,580	3,400	7,980	–	4,000	11,980
	Number of Berths	21*	8	29	–	2	31
	Total Length of Berths (m)	7,600**	2,000	9,600	–	425	10,025
New Ocean Terminal	Cargo Traffic (1,000 ton)	6,606	13,414	20,020	1,042	5,400	26,462
	Number of Berths	33	27	60	1	3	64
	Total Length of Berths (m)	6,105	8,100	14,205	300	555	15,060

* excluding 2,700 m of berths of two lighterage terminals
** including 2,700 m of berths of two lighterage terminals

4-3. Scale and layout of the commercial port facilities

Table 4-2 shows the scale of development of the commercial port facilities at the New Ocean Terminal in the year 2000. The scale of facilities shown in the table has been determined on the basis of the estimated cargo volume in the year 2000 and the required size of vessels. These facilities are to be placed according to the basic principles given under 4-1 (see Fig. 3-1. Master Plan).

Table 4-2 Number and Size of Berthing Facilities for Commercial Cargoes at the New Ocean Terminal in the year 2000

Cargo Traffic, Dimension of Vessels and Berths	General Cargo Berths		Grain Berth	Petroleum Oil Berths	Small Craft Berths	Total
	Break Bulk	Containerized				
Cargo Traffic (1,000 ton/yr.)	6,606	13,414	1,042	5,400	–	26,462
Maximum Size of Vessels (DWT)	15,000	50,000 G.T.	60,000	15,000	280 G.T.	–
Structural Depth of Berths (m)	-10	-12(-13)*	-14	-10	-3.5	–
Length of Each Berth (m)	185	300	300	185	–	–
Total Number of Berths	33	27	1	3	–	64
Total Length of Berths (m)	6,105	8,100	300	555	1,100	16,160
Total Width of Wharf (m)	200	400	300	–	25	–

*At present, the depth of 12 meters is sufficient for most of the modern container ships, but to meet the further increase of ship's size in future an allowance of one metre is taken into consideration for design purposes.

4-4. Layout of related facilities

As port traffic facilities, port roads and a port railways are to be planned.

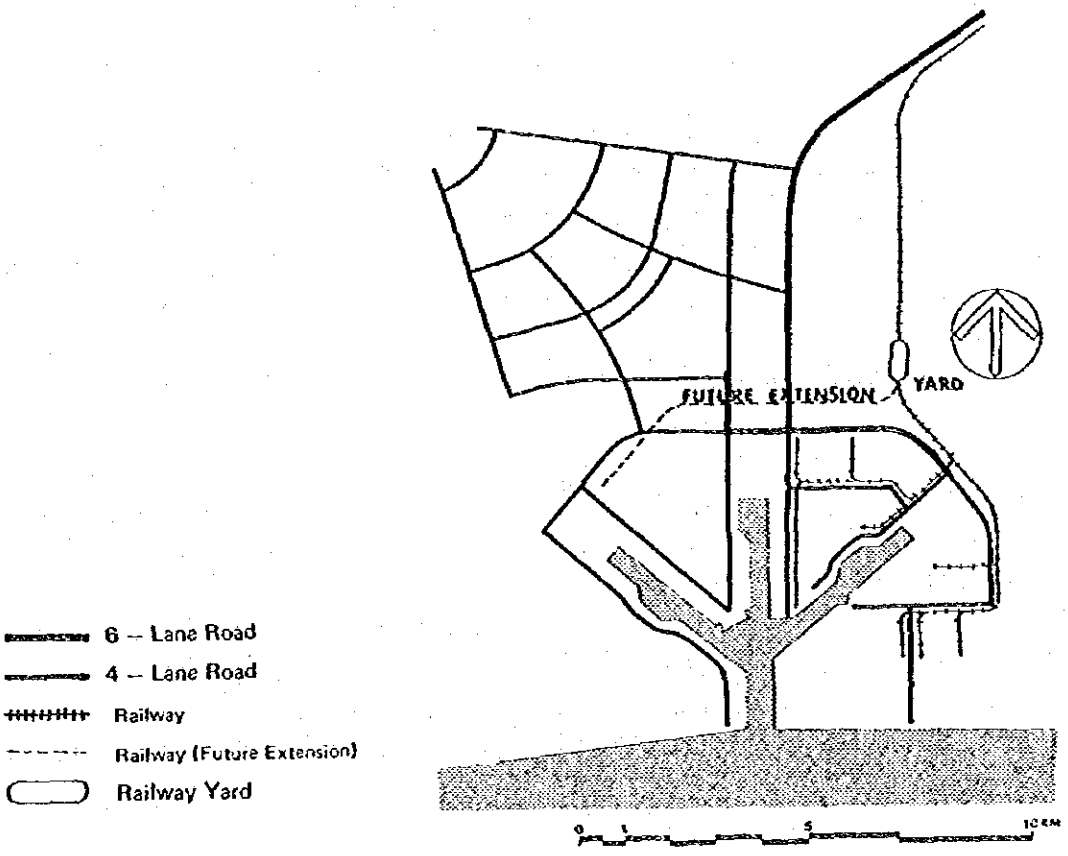
The New Ocean Terminal is a port with both commercial and industrial port functions. Those goods transported from the port to inland are different in kind, transport distance and lot between the commercial port and the industrial port.

Accordingly, appropriate means of land transportation are to be selected for varied goods. Fig. 4-1 shows the layout of port traffic facilities determined taking account of the nature of the cargo handled at the New Ocean Terminal on the final stage, assuming that goods from the industrial port will be transported inland both by rail and by road and those from the commercial port mainly by road. The railway line shown by the dotted line on Fig. 4-1 has been planned for the future possibility of transporting goods from the commercial port by rail.

It will also be necessary to plan land area for port related activities. Needless to say, port activities are not carried out only by basic facilities such as wharfs and channels; it is also necessary to provide various pertinent activities and public service functions to sustain port activities. Accordingly, the New Ocean Terminal is to be provided with about 260ha of land for port related activities and about 15ha for public service functions according to the scale of port activities. Fig. 3-1. Master Plan is to be referred to for layout of related facilities.

The New Ocean Terminal is planned in an area of approximately 14km x 14km, which contains commercial and industrial port facilities, industrial land, transport facilities and urban facilities. These facilities are planned so as to have sufficient space for future expansion in performing their functions. However, in the case of a comprehensive development project such as the proposed New Ocean Terminal Project, in addition to the so-called primary related facilities which are normally considered for such a project, it may be necessary to provide facilities

Fig. 4-1 Basic Layout of the Transportation Facilities



including those which may be called secondary related facilities and those which may be required for more sophisticated environmental improvement for even more advanced projects. In order to meet such requirements, it will be advisable to retain a certain amount of land behind the commercial and industrial port facilities and other areas for future land use. (Reserved area on Fig. 3-2.)

It will be possible to locate in such areas, in addition to high quality parks and green, recreation ground, a large scale refuse processing plant and other facilities for environmental conservation, those facilities such as a truck terminal and a distribution and wholesale complex. However, these needs are more likely to arise in relation to the use of inland areas. It is, therefore, more appropriate at the present stage to reserve land space for such purposes rather than to allocate the land to each of the requirements in the Master Plan.

5. Concept for Industrial Development

5-1. Scales and specifications of industries

Table 5-1 shows the industries to be located under the concept of industrial development at the New Ocean Terminal, production scale, land area, employees and water requirement of each industry at the final stage.

(1) Industries to be located

In addition to the results of the Phase-I Report, this study included edible oil manufacturing as the demand is expected to increase with the population growth and level up of living standard in future.

Characteristics of these industries and of the New Ocean Terminal as an industrial base are as follows.

1) Taking the geographical condition of the site into consideration, the industries which require relatively extensive land area and a long water-front with deep water indispensably for cargo handling are selected. These industries, that is to say are iron and steel, oil refining, petrochemicals, and shipbuilding and repair.

2) Oil refinery provides fuel oil for the industries and also naphtha for petrochemicals and chemical fertilizers, forming altogether an industrial complex linked by pipe line.

3) To promote the consolidation of the industrial foundation and the innovation of the industrial structure of Nigeria, material or intermediate product industries, which require high level technology, such as iron and steel and petrochemicals and advanced engineering industries such as automobile assembly are selected.

4) Flour mill and edible oil manufacturing plant which meet consumer demand in the Lagos Metropolitan area and require the waterfront for incoming raw materials are also selected.

The production scale of these industries have been determined on the basis of future domestic demand and taking account of an economical scale merit, international competitiveness and the material balance between industries. Land area, employees and water consumption have been determined on the base of Japanese data, though the number of employees has been estimated to be 1.2–1.5 times more than the Japanese standard in view of Nigerian conditions.

As a result, the total area of the industrial base including the areas for other related industries and public facilities will be 2,380ha with the total number of employees 30,000. As for industrial water consumption, 397,400 m^3/day of fresh water supplied and 7,831,500 m^3/day of sea water will be required.

(2) General goods traffic

According to production scale of the industries to be located, the generated goods traffic has been estimated in respect to major raw materials, fuels and products. As a result, as Table 5-2 shows, the annual total goods traffic is supposed to be 39,558,000 tons in incoming and 28,180,000 tons in outgoing.

As for the traffic shared by transportation means is supposed with the following considerations.

1) Raw materials are assumed to be seaborne regardless of their origins except for those industries such as petrochemicals, chemical fertilizer and shipbuilding and repair, which receive supplies from the oil refinery or the steel mill within the industrial base.

Table 5-1 Development Scale of Industries in the New Ocean Terminal

Type of Industries	Production Scale	Plant Area (1,000 m^2)	Employment (person)	Fresh Water (1,000 m^3/d)			Sea Water (1,000 m^3/d)
				Total	Recycled	Supplied	
Iron and Steel	Crude Steel 6 million tons/year	7,000	*10,000	2,300.0	2,070.0	230.0	2,150.0
Petroleum Refining	400,000 barrels/day	3,000	1,200	190.0	152.0	38.0	650.0
Petrochemicals	400,000 tons/year (ethylene basis)	2,100	2,350	750.0	690.0	60.0	1,000.0
Chemical Fertilizer	500,000 tons/year	150	200	110.0	100.0	10.0	400.0
Automobile Assembly	200,000 vehicles/year (Two shifts)	1,200	5,000	5.0		5.0	
Shipbuilding and repair	200,000 G.T. dock	450	1,000	1.2		1.2	1.5
Flour Mill and Food Processing	500,000 tons/year	150 **(80)	1,800 **(200)	3.0 **(0.2)		3.0 **(0.2)	
Edible Oil	250,000 tons/year	50	200	12.0	4.8	7.2	
Power Station	One million KW	400	250	3.0		3.0	3,630.0
Sub Total		14,500	22,000	3,374.2	3,016.8	357.4	7,831.5
Other Related Industries		3,800	8,000	40.0		40.0	
Public Space including roads and railways, etc.		5,500					
Total		23,800	30,000	3,414.2	3,016.8	397.4	7,831.5

Notes: * including the employees of related industries ** shows flour mill, which are included in the uppers.

Table 5-2 Industrial Goods Traffic at the New Ocean Terminal

Unit: 1000 ton

Type of Industries (Production Scales per year)	Raw Materials (Input)					Products (Output)					Remarks
	Type of Raw Materials	Volume				Type of Products	Volume				
		Total	Seaborne (public wharf)	by Railway	by Road (by Pipeline)		Total	Seaborne	by Railway	by Road (by Pipeline)	
Iron and Steel (Crude Steel 6 million tons)	Iron Ore Coal Limestone Fuel Oil	8,430 3,330 1,140 458	8,430 3,330 1,140 (92)		 (366)	Steel	5,400	1,620	920	2,760 *100	30% for export for shipbuilding
Petroleum Refining (400,000 barrels/day)	Crude Oil	18,850	18,850			Petroleum Products	17,900	7,160	2,335	5,449 (2,956)	40% for export
Petrochemicals (400,000 tons ethylene basis)	Naphtha Crude Salt Fuel Oil	1,550 150 364	 150 (73)		(1,550) (291)	Derived Chemical products	1,930	965	193	772	50% for export
Chemical Fertilizer (500,000 tons)	Naphtha	200			(200)	Fertilizer	500		100	400	
Automibile Assembly (200,000 vehicles/ two shift)	Parts	250	(250)			Motor Vehicle	195		39	156	
Shipbuilding and repair (200,000 G.T. dock)	Steel	100			*100						
Flour Mill and Food Processing (500,000 tons)	Wheat Grains	500	500			Flour Bran	390 100		78 22	312 88	
Edible Oil (250,000 tons)	Soy Beans	250	250			Soybean Oil Oil cake	44 191		 47	44 144	
Power Station (One million KW)	Fuel Oil	1,400	(1,400)								
Independent Power Station (407,000 KW)	Fuel Oil	686	(137)		*(549)						Iron and Steel 300,000 KW Petroleum refining 32,000 KW Petrochemicals 75,000 KW
Sub Total		37,658	32,650 (1,952)	–	100 (2,956)	Sub Total	26,660	9,745	3,734	10,225 (2,956)	
Other Related Industries	Various Raw Materials	1,900	(1,900)	–		Various Products	1,520		304	1,216	
Total		39,558	32,650 (3,852) Sea Borne Total 36,502	–	100 (2,956)	Total	28,180	9,745	4,038	11,441 (2,956)	

Notes: It is assumed that the seaborne fuel oils are landed through the public wharf (included in the commercial port cargo as 5.4 million tons' petroleum products)
* Transported within the N.O.T.

2) Part of fuels is to be piped from the oil refinery.

3) Export products are to be seaborne.

4) Products for the domestic market are to be transported around 80% by road and the rest by rail by taking account of the volume, domestic supply and transport conditions.

Accordingly, the goods traffic by transportation means will be: of the total incoming volumes of 39,558,000 tons, 36,502,000 tons (92.3%) seaborne, 2,956,000 tons (7.5%) by pipe line and 100,000 tons (0.2%) by road; of the total outgoing volumes of 28,180,000 tons, 9,745,000 tons (34.6%) seaborne, 4,038,000 tons (14.3%) by rail, 11,441,000 tons (40.6%) by road and, 2,956,000 tons (10.5%) by pipe line.

5-2. Layout of industries.

Layout of industries to be located is as shown in the Master Plan. Layout of industries has been arranged by such principles as security of smooth industrial production activities, formation of industrial complex, harmony with external environment, and the effective construction of industrial base. In the concrete, following factors are considered; waterfront and depth of water, combination among different industries, intake and drainage of sea water, direction of wind, operation stage of industries, and effective land use of the entire New Ocean terminal. As a result, iron and steel, oil refining, petrochemicals, chemical fertilizer and shipbuilding and repair are to be arranged in the east zone. Flour mill and edible oil are in the northeast zone. Automobile assembly and other related industries are in the northeast zone behind public wharfs of the East Channel. And the power plant is in the west zone because of its need in an earlier stage.

6. Scale and Layout of Industrial Port Facilities

6-1. Principles

Based on the concept of layout employed for the various functions of the New Ocean Terminal under Chapter 3 and the concept of industrial development under Chapter 5, the layout of industrial port facilities (wharfs to handle exclusively the goods of various enterprises such as petroleum, iron and steel, grain and petrochemical products) has been determined as shown below.

1) As a rule, each plant area is to be provided with a necessary water-front for the handling of raw materials and products. And, the berth for the discharge of crude oil and that for shipment of petroleum products are to be located near the harbour entrance.

2) In order to reduce the amount of dredgings large scale deep water facilities, including facilities exclusively used by the oil refinery mentioned above, are to be located near the harbour entrance.

6-2. Scale and layout of industrial port facilities

The scale of industrial port facilities has been planned for each type of industries shown in Table 6-1 according to the estimated further industrial activities at the New Ocean Terminal.

The total number of berths will be 26 with a total length of about 6,000m. These berths are to be located as shown in the Master Plan according to the basic principles described above.

Table 6-1 Number and Size of Berthing Facilities for Industrial Cargoes at the New Ocean Terminal in the year 2000

Cargo Traffic, Dimension of Vessels and Berthing Facilities	Iron and Steel Berths				Petroleum Oil Berths		Petrochemical Berths		Ship-building & repair Berths	Grain Berths	Total
	Iron Ore	Coal	Lime-stone	Iron & Steel Products	Crude Oil	Refined Oil Products	Crude Salt	Petro-chemical Products	Steel & Equip-ment	Grain	
Cargo Traffic (1,000 ton/yr.)	8,430	3,330	1,140	1,620	18,850	7,160	150	965	*	750	42,395
Maximum Size of Vessels (DWT)	150,000	120,000	50,000	15,000	100,000	50,000	15,000	15,000	15,000	60,000	–
Structural Depth of Berths (m)	-18	-17	-13	-10	-16	-13	-10	-10	-10	-14	–
Length of Each Berth (m)	350	310	270	185	400	270	185	185	185	270	–
Total Number of Berths	2	1	1	9	2	1	1	5	3	1	26
Total Length of Berths (m)	700	310	270	1,665	800	270	185	925	555	270	5,950

* The ship building berths are planned mainly for repairs and fittings, but used occasionally to unload materials for ship repairs, etc.

7. Layout of Breakwaters, Channels and Basins

7-1. Layout of breakwaters and design wave

As the wave data necessary for the determination of the layout of breakwaters, those obtained off Forcados have been used. Characteristics of the wave data may be summarized in the following two points:

1) 84% of waves approach from N to W directions with most frequently direction of SW.
2) Most of them are swells with relatively long wave period in relation to wave height.

The alignment of breakwaters is determined through the computation of wave height in the harbour as shown in Fig. 7-1. As the figure shows, the West Breakwater is protruded by 900m at a right angle to the shoreline, then extended by approximately 2,700m with a slant of 145° in the east direction from north. It has been proved to be capable of maintaining calmness in the harbour. The change in the shoreline due to the position of the breakwaters is shown in Fig. 7-2. Though the eastern side of shoreline has probability of erosion, the erosion may be prevented by appropriate measures against erosion. As for deepwater waves for the design of port facilities, they are determined to be of the wave height of 6m, period of 12 seconds and wave direction of SW by statistical analysis. The design wave height at each depth is summed up on Table 7-1.

7-2. Plans for channels and basins

In the light of the alignment of breakwaters and sounding survey, channels have been determined as shown in Fig. 7-3.

Since the mooring facilities of the New Ocean Terminal have been planned taking account of the estimated future cargo traffic, it will not be necessary to plan waiting basins for incoming vessels and those for lighters. Accordingly, as for basins, only turning basins are to be planned.

Fig. 7-1 Alignment of Breakwaters and Sounding Chart

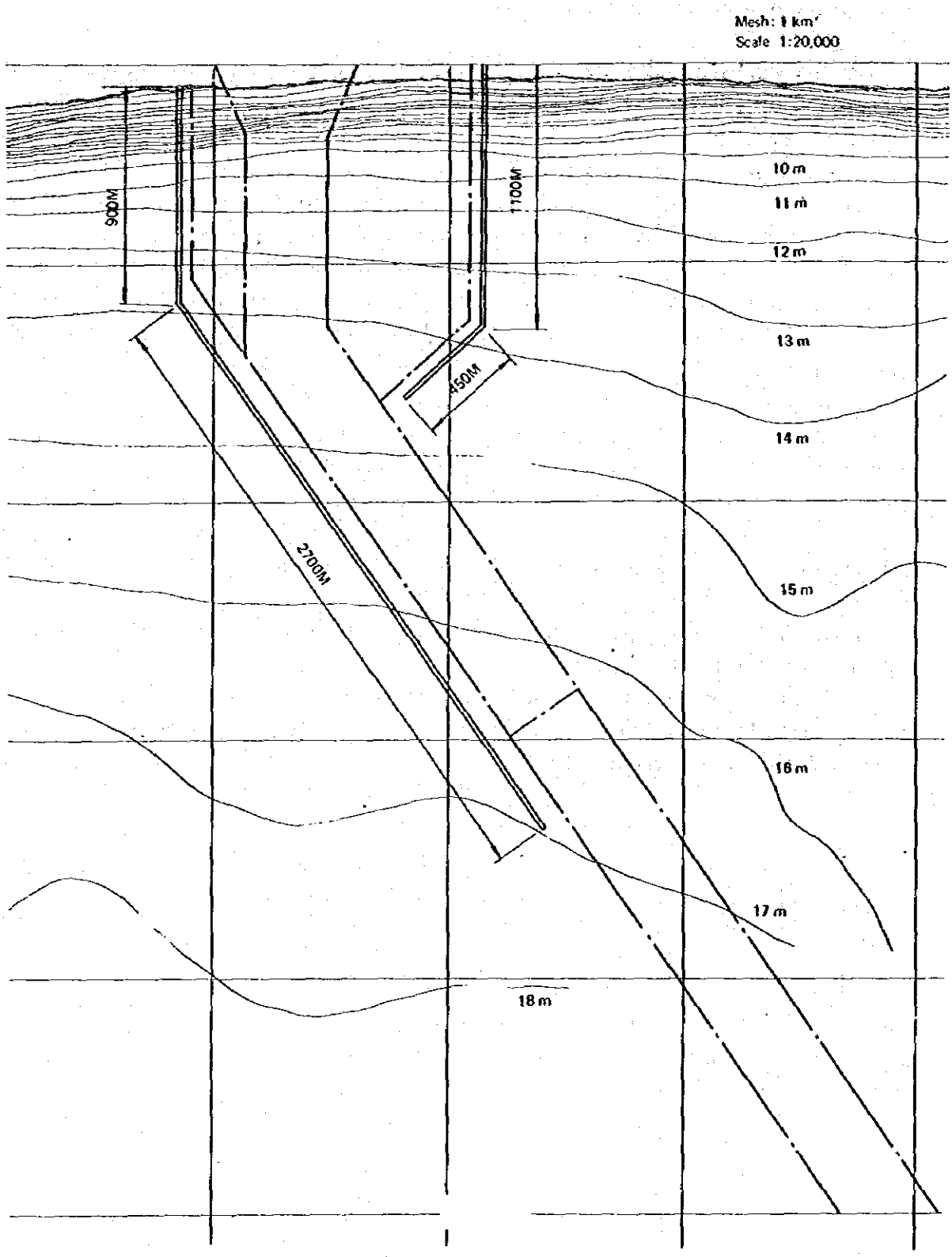


Fig. 7-2 Estimated Variation of Coast-line after Construction of Breakwaters.

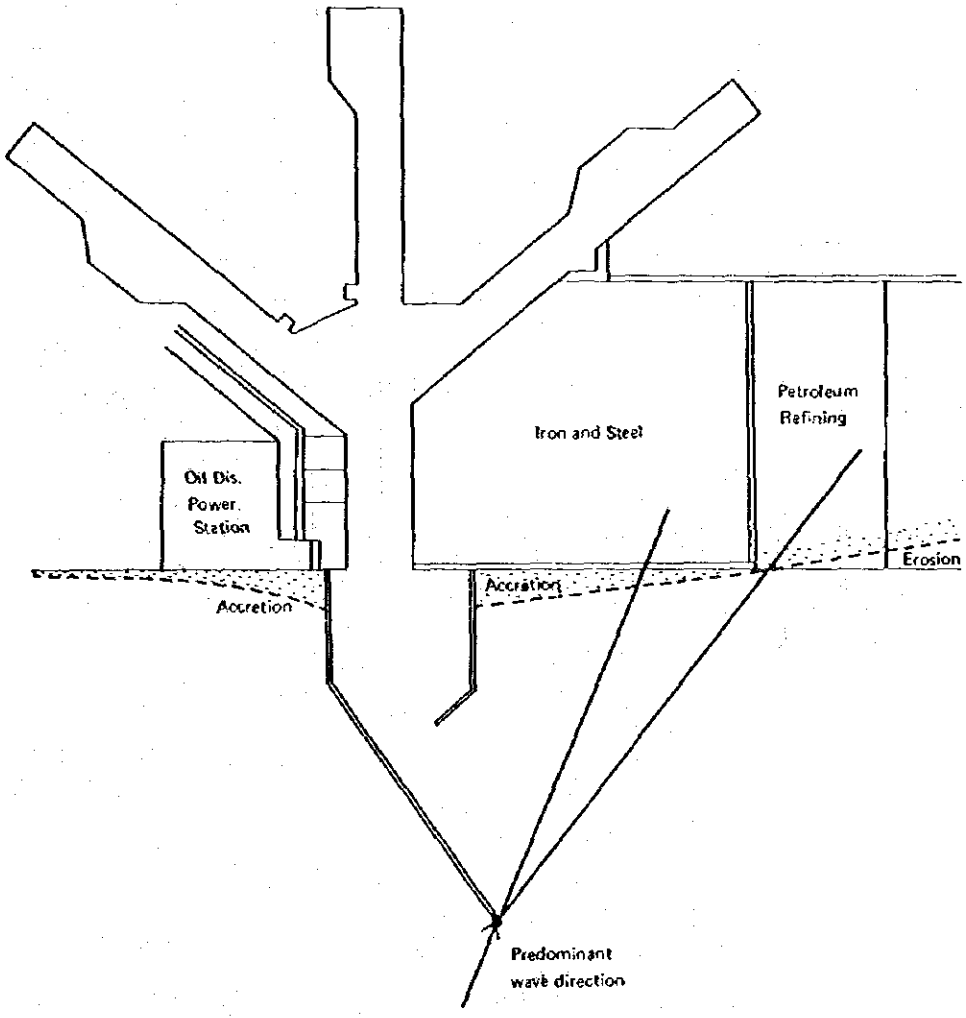


Table 7-1 Variation of Significant Wave Height at Different Sea Depths

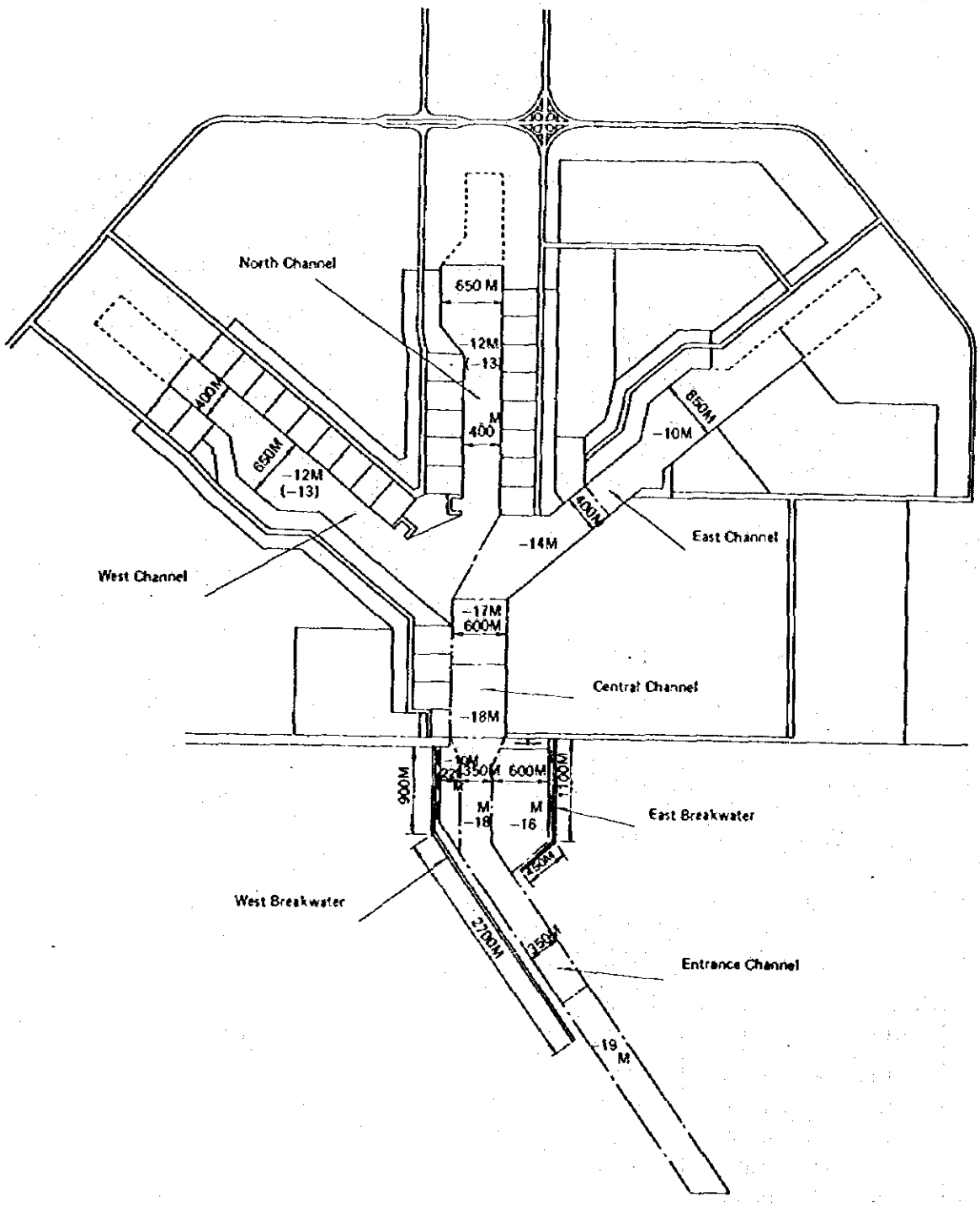
Assumption:
Ho = 6.0 m, To = 12 sec
Wave direction: SW
Sea bottom slope : 1/1000
Coeff. of wave directional concentration : Smax = 20

h (m)	h/Lo	Kr	α	Ho' (m)	$H_{1/3}$ (m)	Hmax (m)
18	0.080	0.87	24°	5.2	4.9	8.6
16	0.071	0.86	23°	5.1	4.9	8.6
14	0.062	0.86	22°	5.1	4.9	8.6
12	0.053	0.85	20°	5.1	4.9	8.6
10	0.043	0.85	18°	5.1	4.9	7.4
8	0.035	0.85	16°	5.1	4.8	6.2
6	0.027	0.84	14°	5.0	3.7	4.9
4	0.017	0.84	11°	5.0	2.7	3.7

h = sea depth
Lo = wave length in deep sea
Kr = refraction coefficient
α = predominant wave angle from south

Ho' = equivalent deep sea wave height
Ho = significant wave height
Hmax = max. wave height

Fig. 7-3 Layout of Channels



8. Concept for the Scale and Layout of Urban Facilities

The realization of the New Ocean Terminal is to be accompanied by large scale of housing construction. Accordingly, systematic construction of urban facilities responding to demand is very important to provide better living standard in future.

8-1. Scale of the New City

As Table 8-1 shows, the total number of employees required under the development plan is expected to be 50,000 in the year 2,000, including 20,000 in relation to the commercial port and 30,000 to the industries. Based on these figures, the total number of employees taking account of an increase in service industries such as commerce is expected to be 83,000 and total population is 200,000

Table 8-1 Employment and Population of the New City

Unit: person

Items	1990	2000
Employees total	3,300	83,000
Transport and Communications *	2,000	20,000
Manufacturing and Processing *	--	30,000
Construction and Building		8,000
Distribution, Electricity and Water	1,300	17,000
Services		8,000
Population	7,500	200,000

Note: * shows employees planned in the New Ocean Terminal Project.

As for the scale of the development area for the New City, it is to be aimed at medium rise housing of medium density (attached houses, 2–4 story apartment houses, etc.) so that good environment may be ensured at a low cost. Experiences of new town developments in various countries and the FESTAC Town development indicate that the optimum population density for favorable environment in the case of medium rise housing would be 70 persons/ha as a gross zone overall population density. Therefore, the figure is used for the proposed development and the total area is estimated to be 2,900ha.

Composition of land use in that case is shown in Table 8-2. The net residential density is thus to be 140 persons/ha and the gross residential density 100 persons/ha.

8-2. Location of the New City

Urban facilities are to be developed as a New City, taking account of the economy of construction, convenient utilization of urban facilities and conservation of environment.

After comparing four alternative plans, it has been decided that the location of the New City is within 10km from the centre of the New Ocean Terminal either on the northwest side,

Table 8-2 Required Land Use and Infrastructure in the New City

Land Use Category	Area of Land Use (ha)	
	1990	2000
Residential Area	50	1,450
Commerce and Office	4	120
Public Facilities	6	170
Roads	20	580
Open Space	20	580
Land use Total	100	2,900

Infrastructure	(Unit)	(Total)
Water Supply	130ℓ/day·person	26,000 m^3/day
Sewerage	130ℓ/day·person	26,000 m^3/day
Electric Power Generating Capacity	0.2 KW/person	40,000 KW
Telephone Connections	1 set/5 person	40,000 sets

where it is expected to be free from environmental impact due to the industrial complex, convenient for commuters and close to the Lagos Lagoon.

8-3. Concept of the layout of urban facilities

The layout of various facilities of the New City is planned as below, taking account of topographic conditions of the development area, amenities for residents, etc.

First, most of service industries are planned to be concentrated into a single town centre so as to make use of the merits of the scale. The centre is to be surrounded by medium and high rise housing areas in such a way that about 80,000 people live within 8 minutes and about 130,000 people within 15 minutes on foot from the centre which will then be used by 65% of the total population for their daily life.

A road network based on urban arterial roads is planned to deal with heavy commuting traffic between the New Ocean Terminal and the New City. It also forms the basic framework of the New City to induce the future development in the north and west directions.

The environs of the New City are mainly planned for recreation. And the water-front of the Lagos Lagoon is to provide with a marina and an inland waterway terminal to Lagos and other cities.

The water-front of Omu Creek is to provide with facilities such as sport grounds, boating and loadging for visitors. Further, facilities such as a college and hospital are to be positioned at the eastern end of the New City where convenient and quiet environment can be maintained.

Table 8-3 gives the results of a study on construction costs of urban facilities. These are quite rough cost estimates on the basis of recent construction projects in Nigeria, information obtained from Lagos State Government and recent projects in other countries.

Table 8-3 Construction Cost for the New City

Unit: million ₦ 1978 current price

Public Sector	
Infrastructures *	410–600
Open Space & Recreational Facilities **	10–20
Architectures for Public Services ***	110–150
Public Sector Total	530–770
Private Sector	
Housing ****	430–620
Architectures for Commerce & Business	240–360
Private Sector Total	670–980
New City Total	1,200 – 1,750

Notes
* This item includes deforestation, roads, water & electric energy supply, sewerage and storm water drainage, but excluds cut/fill because of uncertainty of the topography.
** This item includes parks, open space, a golf field, a recreational port and an inland waterway terminal.
*** This item includes facilities for administration, education, health and social welfare.
**** Housing includes telephone connections.

9. Plan for Arterial Transportation Facilities

9-1. Basic concept for the planning of arterial transportation facilities

With regard to the planning of arterial transportation facilities, present transport conditions and relevant future plans were ascertained on the basis of the O-D survey conducted at Apapa and Tin Can during the field survey period in December, 1978, interviews with the authorities concerned and other data obtained.

There is a plan to improve the railways in Nigeria by standardizing the gauge. At present, however, almost all goods are transported by truck. According to a report on the plan for standardizing the gauge, rail transportation is considered to be more advantageous for hauling distances exceeding 360km. Since the New Ocean Terminal is similar in nature to the existing Port of Lagos, if it is maintained the same transportation pattern as that of the port of Lagos, 85% of cargoes through the commercial port will be transported to the Metropolitan Area. Accordingly, under the present transport plan, facilities are to be designed with 2000 as the target year on the assumption that industrial goods produced by the seaboard industries planned at the New Ocean Terminal are to be transported in part by rail and that commercial port goods are to be transported entirely by road. However, to be prepared for future changes in transportation modes, a right of way is to be secured so that port railway sidings may be provided for the commercial port. Passenger transportation is planned to be entirely by vehicle.

With regard to the transportation network, roads are to be linked to the existing Ikorodu-Epe road. The railway line will run up to Ibadan and be linked to the proposed standard gauge trunk line running North-South from Lagos to Kano.

9-2. Planned traffic volume

(1) Business traffic

With regard to the annual quantity of goods to be handled at the commercial and industrial port, and the modal split, these have been ascertained, as Table 9-1 shows, on the basis of the scale and layout of the commercial port facilities under Chapter 4 and the concept for industrial development under Chapter 5.

As for business traffic, on the basis of these figures (in tons), the empirical formula used at present in Japan and the coefficient obtained from traffic surveys in Nigeria have been used to determine the generated business traffic volume at peak hours by trucks and related vehicles. Further, assuming a distribution pattern, traffic assignment has been applied to the road network shown in Fig. 9-1 in terms of equivalent passenger car unit. The planned number of trains has also been obtained on a certain assumption as 24 round trips.

(2) Commuter traffic

Passenger traffic related to the New Ocean Terminal is to be entirely by car and it is assumed that the moring and evening peak hours will consist entirely of commuter traffic.

On the basis of the number of employees, traffic volume in terms of one-way flow at peak hours has been obtained and assigned to the road network as shown in Fig. 9-2. As a result, the required number of lanes for all roads within the development area except a main access road are determined by commuter traffic.

9-3. Transportation network plan

As a result of the above study, the transportation network shown in Fig. 4-1 has been proposed.

9-4. Scale and construction cost of transportation facilities

Table 9-2 shows the scale and construction cost of transportation facilities by transport modes and standards.

Table 9-1 Generated Cargo Flow in the year 2000 by Type of Commodities and Transport Modes

Unit: 1,000 tons

Type Commodity	Nigeria & Lagos State	Community	Industrial Complex	New Ocean Port
Road A				
Container	(2,442)	(42)	100%T	(2,484)
Break Bulk	(3,522)	(82)	100%T	(3,604)
Grain	(1,028)	(14)	100%T	(1,042)
Petroleum product distribution	(5,273)	(127)	100%T	(5,400)
Road B				
Container	(4,394)	(76)	100%T	(4,470)
Road C				
Container	(2,442)	(42)	100%T	(2,484)
Break Bulk	(978)	(23)	100%T	(1,001)
Road D				
Container	(3,909)	(67)	100%T	(3,976)
Automobile Assembly	T(156) R(39)	80%T20%R	(195)	
Other Related Industries	T(405)			
Road E				
Other Related Industry	T(811) R(304)	80%T20%R	(1,520)	
Break Bulk	T(1,955)	(46)	100%T	(2,001)
Flour Mill and Food Processing	T(588) R(147)	80%T20%R	(735)	
Road F				
Iron & Steel Products	T(2,760) R(920)	75%T25%R	(3,680)	
Petroleum Refining	T(5,449) R(2,335)	70%T30%R	(7,784)	
Petrochemicals	T(1,172) R(293)	80%T20%R	(1,456)	

T: $37,284 \times 10^3$ tons
R: $4,038 \times 10^3$ tons

T: Truck
R: Rail

Fig. 9-1 Traffic Assignment for Business Traffic
(Equivalent Passenger Car Unit)

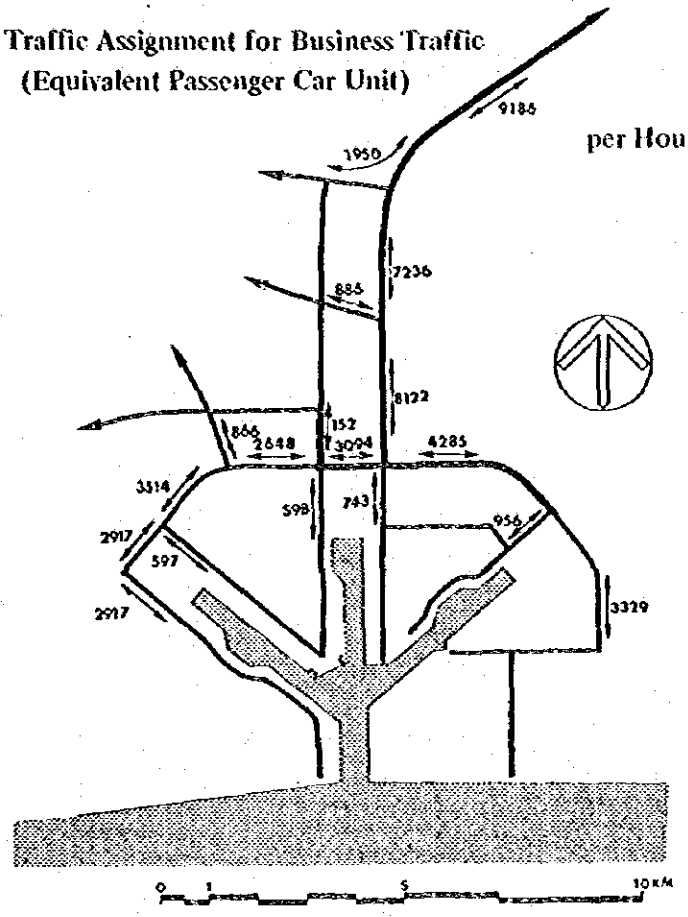


Fig. 9-2 Traffic Assignment for Commuter Traffic
(Equivalent Passenger Car Unit)

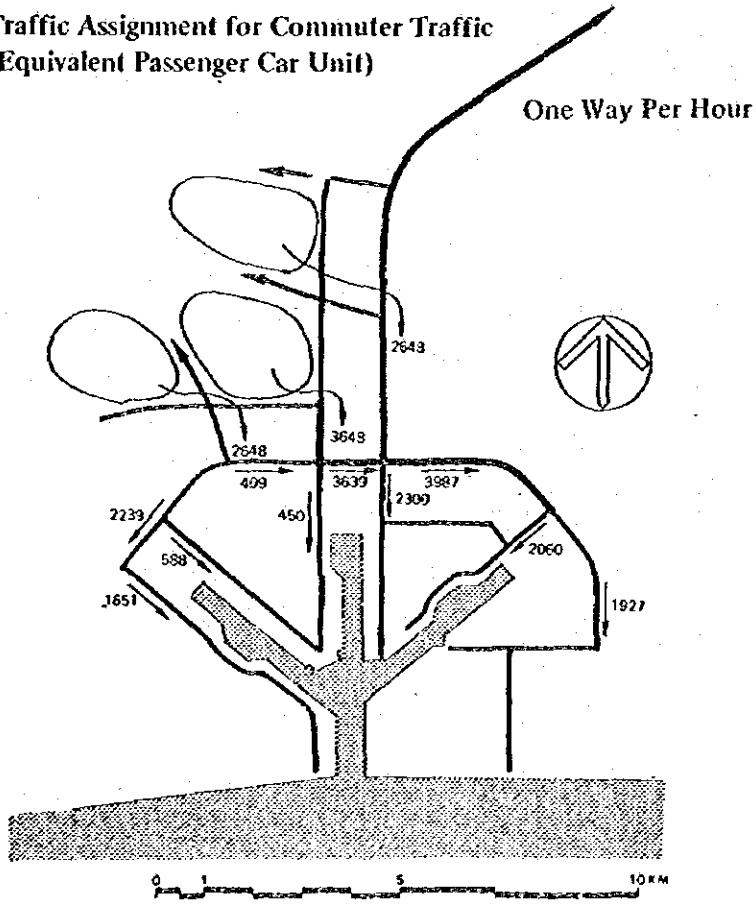


Table 9-2 Construction Cost for Transportation Facilities in the Development Area

Arterial Road	Quantity		Construction Cost (million ₦)		
	Embankment Length (km)	Structure	Embankment Section	Structure	Total
Main Access Road 6-lane	12.0	Trumpet I.C. 1 Unit	30.0	4.0	34.0
Ring Road 6-lane	5.2	Crover I.C. 1 Unit	13.0	6.0	19.0
4-lane	8.3	Diamond I.C. 3 Unit	16.0	9.0	25.0
Port Road 4-lane	31.0	–	62.0	–	62.0
Urban Arterial 4-lane	46.5	–	93.0	–	93.0
				Road Total	233.0
Railway					
Port Railway	30.5	Yard 1 Unit	30.5	3.0	33.5
Main Access Railway	6.5	Junction 1 Unit	6.5	1.5	8.0
				Railway Total	41.5
			Transportation Total		274.5

Table 9-3 Construction Cost for Transportation Facilities out of the Development Area

	Quantity		Construction Cost (million ₦)		
	Embankment (km)	Structure (m^2)	Embankment Section	Structure	Total
Main Access Road 6-lane	8.7	21,000	21.8	37.7	59.5
Main Access Railway	107.8	3,000	107.8	6.0	113.8
				Transportation Total	173.3

10. Concept for Divisional Development

In general, large scale development, not to speak of harbour development, cannot be completed in a short period; in fact it takes a long period of time for completion. It is, therefore, necessary to divide the project into stages to increase investment efficiency by planning the project in such a way that it will be possible to commence partial service.

Further, if the target year is far ahead, chances of uncertainty creeping into the forecast of various components of the project will increase. Thus, if investments are made at the initial stage in such a way as to determine the final form of the project, it is probable that contingency offsets the effects of investments.

In order to cope with such uncertainty, it will be necessary to give sufficient consideration to the phases of development so that those facilities provided for the definite demand in the near future may not be detrimental to the response to changing circumstances in future.

The development of the New Ocean Terminal is one of those projects for which such divisional development is extremely important. As has been mentioned in Phase-I Report and in above Chapters, the scale of the development of the New Ocean Terminal is considerably large, and the development is planned on virgin land which is at a distance from the existing urban accumulation.

Further, compared with the certainty of future demand for commercial port facilities, the possibility of industrial location is somewhat uncertain. In addition, taking account of the present condition of the Lagos Ports Complex, it will be appropriate to divide the development into two stages (1990 and 2000) and plan to commence partial service in respect of the commercial port facilities in the year 1990.

Based on such a viewpoint, the state of the New Ocean Terminal in 1990 has been studied on the points given below.

1) Emphasis is placed on the commercial port facilities for which definite demand can be expected in the year 1990;

2) Since the development scale of commercial port functions in 1990 will be relatively small it will not be attractive to large scale industrial location. Accordingly, large scale industrial location is not to be expected in the year 1990;

3) In that case, various facilities are to be positioned in such a way that future expansion may not be hindered and construction order may not be reversed;

4) In particular, breakwaters are to be constructed so as to ensure minimum calmness in the harbour to reduce the initial investment;

5) Necessary facilities are to be positioned at one place so long as it is possible to avoid unnecessary road construction, dredging, etc.

Based on the above approach, the New Ocean Terminal is to provide those port functions in 1990 shown quantitatively in Table 10-1.

Table 10-1 Development Scale of Commercial Port Facilities at the New Ocean Terminal in the year 1990

Cargo Traffic, Dimension of Vessels and Berths	General Cargo Berths		Grain Berth	Petro-leum Oil Berth	Small Craft Berths	Total
	Break Bulk	Contain-erized				
Cargo Traffic (1,000 ton/yr.)	1,207	3,006 G.T.	964*	2,100	–	7,277
Maximum Size of Vessels (DWT)	15,000	50,000	30,000	15,000	280GT	–
Structural Depth of Berth (m)	-10	-12(-13)	-12	-10	-3.5	–
Length of each Berth (m/Berth)	185	300	300**	185	–	–
Total Number of Berths	6	6	1	2	–	15
Total Length of Berths (m)	1,110	1,800	300	370	300	3,880
Width of each Wharf (m)	200	400	300	–	25	–

* Including 180,000 ton of cement. All imported cement is going to be replaced by domestic production in the year 2000.

** The length of the grain berth is set to meet the maximum size of vessels (60,000 DWT) in the year 2000

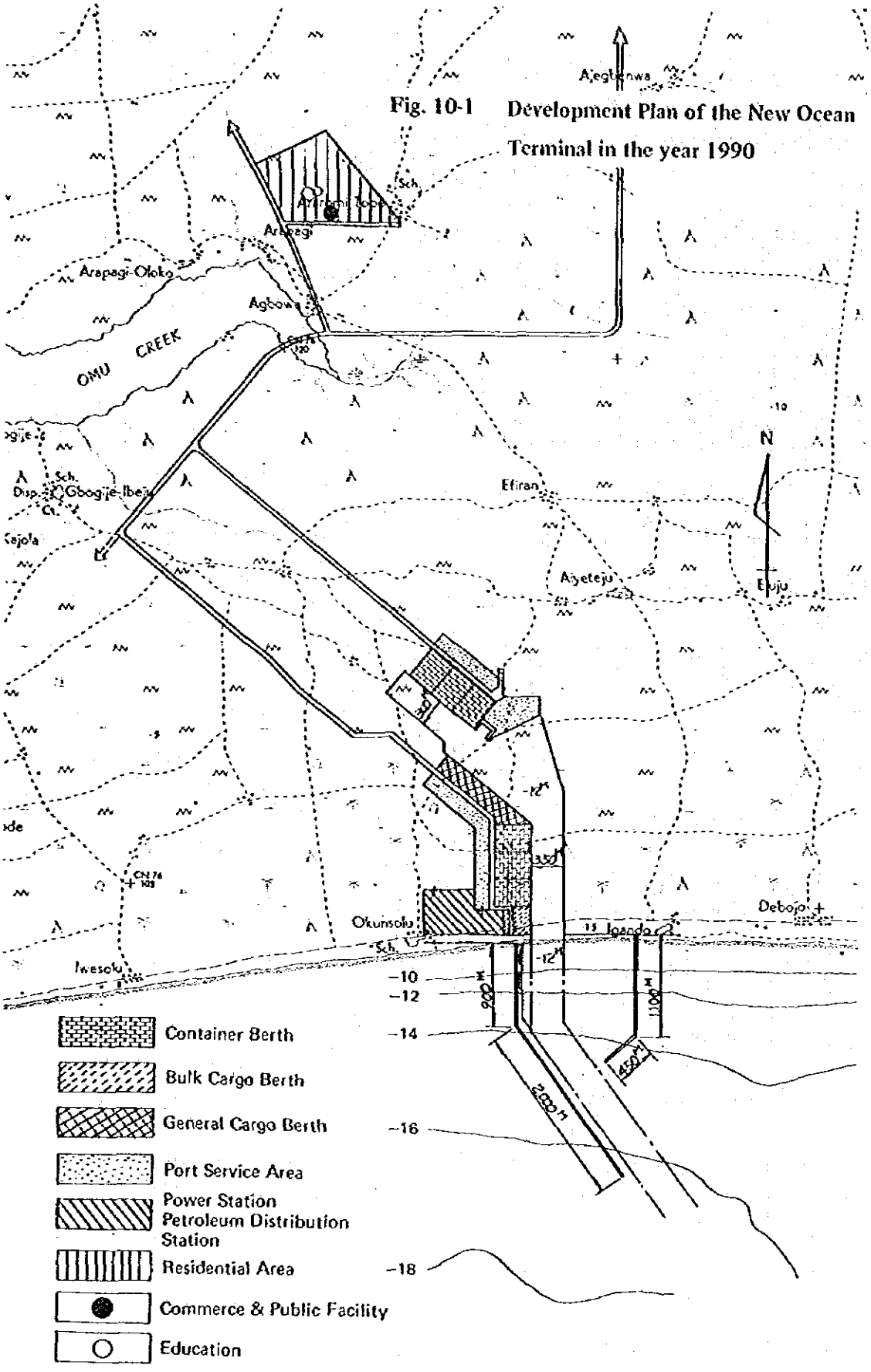


Fig. 10-1 Development Plan of the New Ocean Terminal in the year 1990

11. Preliminary Design of the Basic Port Facilities

11-1. Breakwaters

For the construction of breakwaters local materials are to be used as much as possible, and rubble mound breakwaters are to be constructed where rubbles weighing 8 tons do not suffer damage. In other areas composite breakwaters are to be adopted by placing concrete caissons on rubble mound.

Those areas where 8 tons of rubbles have sufficient endurance are at a depth of less than 6.5m. Composite breakwaters are to be used where the depth is more than 6.5m.

The width of the breakwater has been determined in such a way that the safety factors against sliding and over turning are over 1.2 respectively for design wave height. Crest height is to be +3m, more than 0.6 times incident significant wave height. Foot protection blocks are to be placed on both sides of concrete caisson of the composite breakwater.

Fig. 11-1 shows a design section of the composite breakwater at a depth of −16m and Fig. 11-2 a design section of the rubble mound breakwater at a depth of −6m.

11.2. Mooring facilities of the commercial port

1) Design conditions

Tide level:	H.W.L. +1.00 M
	L.W.L. ±0.00 M
Earthquake:	Not to be taken into consideration as there are no precedents.
Soil:	Estimated as Fig. 11-3 from the results of boring

2) Preliminary design: Shown in Table 11-1

3) Type of structure

General cargo berth:	Open type.
Container berth:	Open type.
Grain berth:	Open type.
Petroleum berth:	Dolphin type.
Small craft berth:	Sheet pile type.

Fig. 11-4 shows a design section of the general cargo berth and Fig. 11-5 the container berth.

Fig. 11-1 Crosssection of Composite Breakwater at −16m Depth

Scale 1:300

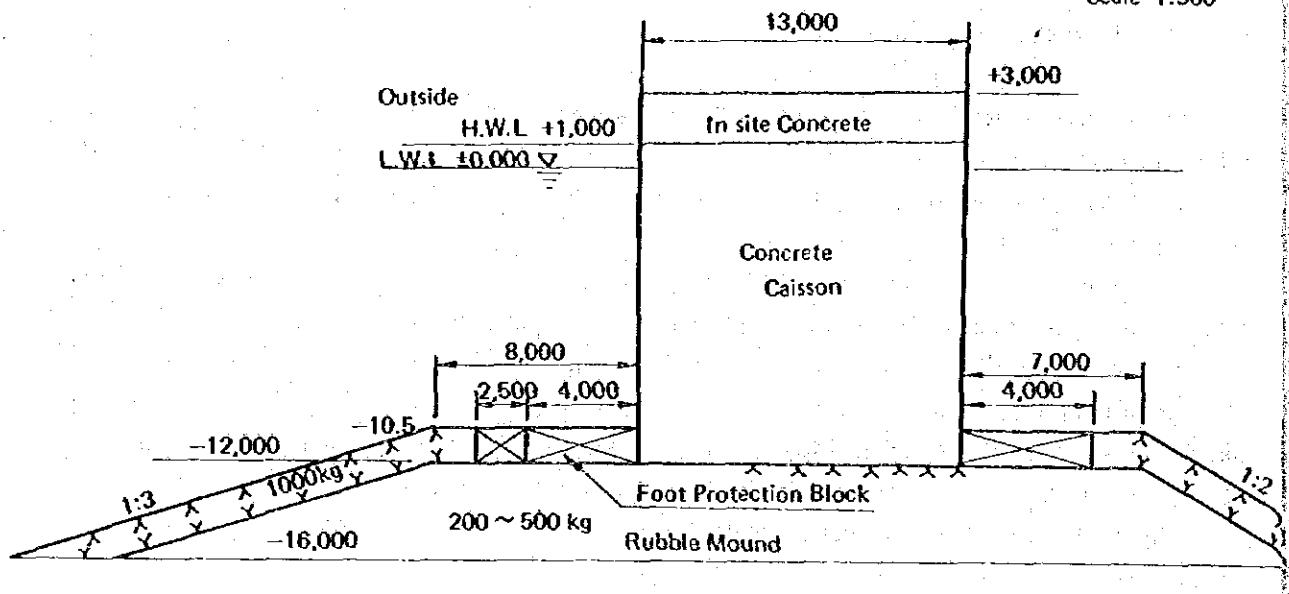


Fig. 11-2 Crosssection of Rubble Mound Breakwater at −6m Depth

Scale 1:300

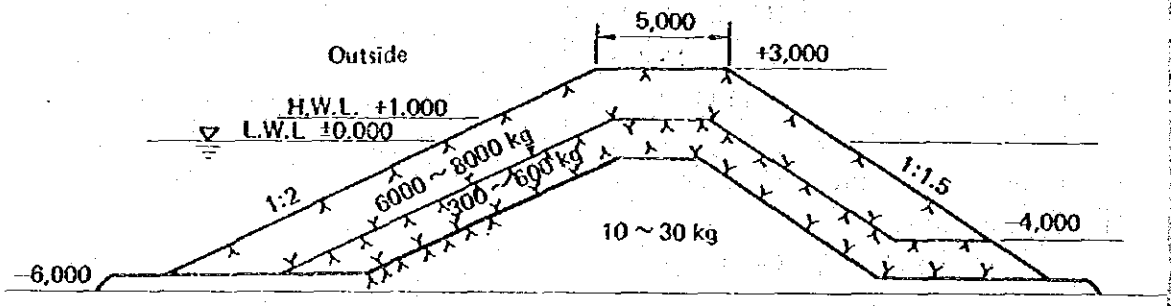


Fig. 11-3 Stratum of Subsoil

E.G.L +3.0M

Sand $\bar{N}$=15

-10.0M

Sandy Clay $\bar{N}$=20

-20.0M

Sand $\bar{N}$=25

-30.0M

Sand $\bar{N}$=40

Table 11-1 Design Conditions of Berths

	General Cargo Berth	Container Berth	Bulk Cargo Berth	Petroleum Berth	Small Crafts Berth
Design Conditions					
Crown Height (m)	+3.0	+3.0	+3.0	+4.0	+2.0
Surcharge (t/m²)	2.0	1.0	2.0	–	0.5
Design Depth (m)	-10	-13	-14	-10	-3.5
Design Length (m)	185	300	300	185	
Size of Vessels (D.W.T)	15,000	50,000 GT	60,000	15,000	280G.T
Berthing Speed of Vessels (m/sec)	0.15	0.15	0.15	0.15	0.20
Cargo Handling Facilities					
Type	Mobile Crane	Container Crane	Pneumatic Unloader	Loading Arms	–
Capacity (t/hr)	–	–	400	1000	–
Lifting Load (t)	Maximum Lifting Load 20	Net Lifting Load 30.5	–	–	–

Fig. 11-4 Typical Section of General Cargo Wharf

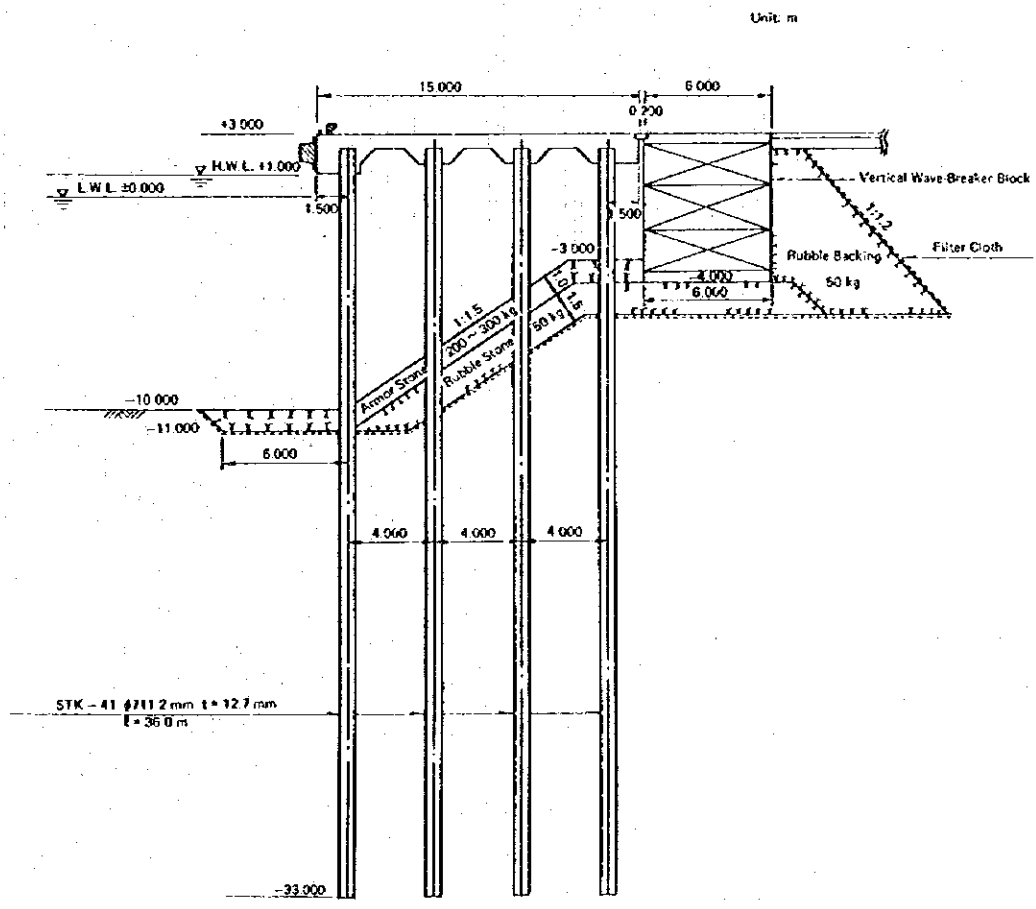
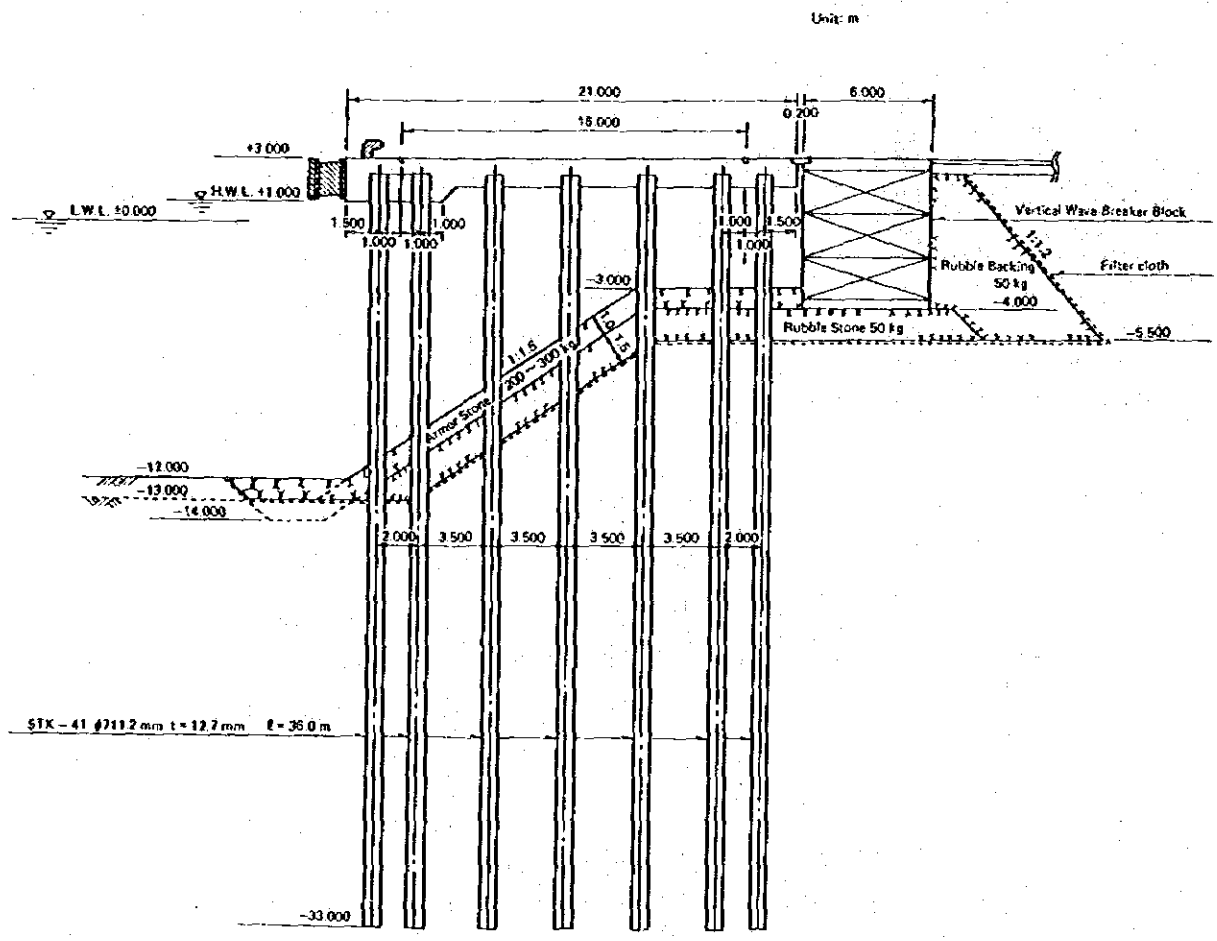


Fig. 11-5 Typical Section of Container Wharf



12. Rough Estimates of Construction Cost

12-1. Construction methods for basic port facilities

(1) Breakwaters

i) Quantity of materials

Table 12-1 shows the approximate estimates of quantities of materials necessary for the construction of breakwaters obtained from the sections determined by the preliminary design.

Table 12-1 Quantity of Materials for Breakwaters

	Type	Length	Materials	Quantity
I. First Stage West Breakwater	Rubble Mound Breakwater	185m	Stone	19,000 m^3
	Composit Breakwater	2715m	Stone Caisson Concrete	442,000 m^3 181 Pieces 113,000 m^3
East Breakwater	Rubble Mound Breakwater	220m	Stone	23,000 m^3
	Composit Breakwater	1330m	Stone Caisson Concrete	182,000 m^3 88 Pieces 56,000 m^3
II. Final Stage West Breakwater	Composit Breakawter	700m	Stone Caisson Concrete	156,000 m^3 47 Pieces 29,000 m^3

ii) Method of construction

a) Transportation and dumping of rubbles

A temporary loading wharf is to be planned near Itokin, north side of the Lagos Lagoon, and a road for the transportation of rubbles is expected to be provided (about 30km) from the quarry to the wharf.

The rubbles quarried out are to be transported by large sized dump trucks to be loaded at the wharf on to a rock carrier of 500m^3 class. The rock carrier is to be pushed by a 1,500 HP class push boat, through the Lagos Lagoon to the open sea, and finally to the dumping point, about 100km away, where dumping is carried out by opening the bottom door. However, those to be used for the rubble mound breakwater are to be transported by dump trucks and placed in by a crane to form a prescribed section.

b) Mound of the composite breakwater

Those rubbles dumped are to be arrange by a small floating crane and by divers to form a prescribed section.

c) Caisson

Caissons are to be produced on a sandy ground within the project area.

(2) Dredging and reclamation

i) Dredging quantity

Table 12-2 shows approximate volume obtained from the area, depth, etc., ascertained by the plan for channels and basins.

Table 12-2 Approximate Volume of Dredging

(Unit: million m^3)

	First Stage	Final Stage	TOTAL
Commercial Port	28	58*	86
Industrial Port	–	19	19
TOTAL	28	77	105

* This figure contains the amount of soil equivalent to an area of 300 m in width with a depth of 10 m, required for the commercial port using the east channel.

ii) Method of dredging

Dredging is to be carried out by two 8,000HP class and one 2,000HP class cutter suction dredgers. The dredged material is to be used mainly for raising low-lying areas. During the first stage of the project (target year 1990), dredged material is to be used for raising of the ground level of the commercial port area and its vicinity. Disposal planning of the dredged materials by the time of the final target year of 2000 is to be determined after detailed study of topographic conditions of the project site and its environs.

Initial dredging shall be started at a point of shoreline protected by temporary rubble breakwaters. Dredging is then to proceed along the front slope of the mooring facilities so that piling may commence soon.

iii) Mooring facilities

After the completion of dredging, piling is to be carried out by pile driving barges, starting with the section near the harbour entrance, excluding the wharfs near the shoreline. After calmness in the vicinity has been secured by breakwaters, the front slope of the grain and petroleum berths are to be deredged and mooring facilities of these berths are to be constructed.

Small craft berths are to be constructed by land-based machinery.

12-2. Work schedule of port construction

At this stage of study it is not possible to prepare a definite work schedule. However, Table 12-3 has been prepared to provide a concept for the estimate of construction cost. This is for the first stage (target year 1990) allowing seven years for the entire work schedule.

Table 12-3 Work Schedule (First Stage)

Item	Quantity	1 yr / 12 mth	2 / 24	3 / 36	4 / 48	5 / 60	6 / 72	7 / 84
Preparation	Sum							
Temporary Work*	Sum							
Breakwaters	4,450 m							
Dredging & Reclamation	28,000,000 m³							
Mooring Facilities & Related Land Facilities	15 Berth							
Others**	Sum							

* Temporary Work includes mainly construction of temporary roads, temporary wharfs, temporary breakwaters, temporary buildings and yards.

** Others include utilities, navigation aids, port service boats, power station and site clearance.

12-3. Conditions of the cost estimates

1) The exchange rate is to be ₦ 1 = ¥300.
2) This estimate is based on unit prices in the year 1978.
3) Since there are no major construction firms in Nigeria for the time being foreign contractors must be employed.
4) All the materials for construction are assumed to be imported except timbers, stones, aggregates which can be produced locally.
5) The foreign currency component is calculated tentatively according to the characteristics of works.
6) The construction cost at the final stage includes that of the industrial port will be constructed at this stage.
7) As for the industrial port, construction cost has been estimated on the basis of the types of structures shown in Table 12-4.
8) The construction cost does not include cost of land purchase, compensation, and consultant fees.

Table 12-4 Types of Mooring Facilities in Industrial Port

Mooring Facilities	Type of Structures
Iron and Steel Berth	
Iron Ore Berth	Detached Pier
Coal Berth	Detached Pier
Limestone Berth	Detached Pier
Steel Product Berth	Open-type Wharf
Oil Berth	
Crude Oil Berth	Dolphin
Refined Oil Berth	Dolphin
Oil Chemicals Berth	
Oil Chemical Materials	Open-type Wharf
Oil Chemicals	Open-type Wharf
Shipbuilding Berth	Open-type Wharf
Bulk Cargo Berth	Open-type Wharf

12-4. Rough estimates of construction cost of port facilities

Table 12-5 shows the roughly estimated construction cost calculated on the basis of the above principles.

Table 12-5 Rough Estimates of Construction Cost

Unit: million ¥

(1) Commercial Port

Item	Quantity			Total (Master Plan)			First Stage			Final Stage		
	Total	First	Final	Total	F/C[1]	L/C	Total	F/C	L/C	Total	F/C	L/C
I. Preliminary and Temporary Work[2]	Sum	Sum	Sum	55.5	39.0	16.5	32.2	22.3	9.9	23.3	16.7	6.6
II. Breakwaters and Shore Protection Facilities												
1. Breakwaters	5,150m	4,450m	700m	111.8	89.4	22.4	94.3	75.4	18.9	17.5	14.0	3.5
2. Shore Protection Facilities	2,000m	2,000m	–	10.1	8.1	2.0	10.1	8.1	2.0	–	–	–
III. Mooring Facilities and Related Facilities[3]												
1. General Cargo Berth	33B	6B	27B	175.0	132.8	42.2	31.8	24.0	7.8	143.2	108.8	34.4
2. Container Berth	27	6	21	746.9	605.0	141.9	166.0	134.5	31.5	580.9	470.5	110.4
3. Bulk Cargo Berth	1	1	–	35.7	28.2	7.5	35.7	28.2	7.5	–	–	–
4. Petroleum Berth	3	2	1	34.5	26.9	7.6	23.0	17.9	5.1	11.5	9.0	2.5
5. Small Crafts Berth	1,100m	300m	800m	2.5	2.1	0.4	0.7	0.6	0.1	1.8	1.5	0.3
IV. Dredging and Reclamation	86,000 $\times 10^3 m^3$	28,000 $\times 10^3 m^3$	58,000 $\times 10^3 m^3$	165.6	129.1	36.5	53.9	42.0	11.9	111.7	87.1	24.6
V. Administration Office and Related Buildings	Sum	Sum	Sum	8.2	6.5	1.7	6.8	5.4	1.4	1.4	1.1	0.3
VI. Utilities												
1. Water Supply	Sum	Sum	Sum	16.3	13.0	3.3	10.9	8.7	2.2	5.4	4.3	1.1
2. Sewage and Drainage	Sum	Sum	Sum	11.0	6.6	4.4	3.0	1.8	1.2	8.0	4.8	3.2
3. Electricity Supply	Sum	Sum	Sum	9.0	8.1	0.9	3.0	2.7	0.3	6.0	5.4	0.6
4. Road and Green Belt for Port Service Area	Sum	Sum	Sum	8.3	5.0	3.3	2.0	1.2	0.8	6.3	3.8	2.5
5. Communications System	Sum	Sum	Sum	3.0	2.7	0.3	1.0	0.9	0.1	2.0	1.8	0.2
VII. Navigation Aids				4.0	3.5	0.5	2.5	2.2	0.3	1.5	1.3	0.2
VIII. Port Service Boats				9.6	9.6	–	5.3	5.3	–	4.3	4.3	–
IX. Power Station	400MW	100MW	300MW	88.0	72.0	16.0	22.0	18.0	4.0	66.0	54.0	12.0
Total				1,495.0	1,187.6	307.4	504.2	399.2	105.0	990.8	788.4	202.4
X. Physical Contingency[4]												
Grand Total				1,495.0	1,187.6	307.4	504.2	399.2	105.0	990.8	788.4	202.4

Note: 1 F/C and L/C are foreign and local currencies respectively.
2 Temporary work includes mainly construction of temporary roads, temporary wharfs, temporary breakwaters, temporary buildings and yards.
3 Related Facilities include cargo handling equipment, transit sheds, warehouses, roads, parking areas, green belts and open storage yards which relate to respective berths.
4 Physical contingency is not added.

(2) Industrial Port

Unit: million ₦

Item	Quantity	Cost
I. Preliminary and Temporary Work	Sum	11.5*
II. Mooring Facilities		
1. Iron and Steel Berth		
a. Iron Ore Berth	2 berth	30.9
b. Coal Berth	1 berth	13.2
c. Limestone Berth	1 berth	6.8
d. Steel Product Berth	9 berth	29.1
2. Oil Berth		
a. Crude Oil Berth	2 berth	5.3
b. Refined Oil Berth	1 berth	2.0
3. Chemicals Berth		
a. Chemical Materials	1 berth	3.2
b. Chemicals	5 berth	16.1
4. Shipbuilding Berth	3 berth	9.7
5. Bulk Cargo Berth	1 berth	11.3
III. Dredging & Reclamation	19,000 x 10^3 m^3	36.6
Total		175.7

* The cost of preparation and temporary work is only for the mooring facilities and dredging of industrial port.

12-5. Rough estimates of construction cost of the New Ocean Terminal

Table 12-6 shows the construction cost of the New City, arterial transportation facilities and port facilities for information purposes.

Table 12-6 Total Construction Cost of the New Ocean Terminal

Unit: million ₦

Facilities	Total (Master Plan)	First Stage 1990	Final Stage 2000
New City[1]	650	25	625
Arterial Transportation Facilities[2]	356	24[3]	332
Commercial Port[4]	1,495	504	991
Industrial Port	176	–	176
Total	2,677	553	2,124

Note: 1 For the urban facilities, only the infrastructures and architectures for public services are taken into account, and the intermediate values of estimates ranging over a certain width are indicated respectively.

2 This construction cost includes the costs inside and outside the area of development as shown below.

	First Stage* Million ₦	Final Stage Million ₦
Inside the area of development	15	167
Outside the area of development	9	165

* Railway facilities are not included.

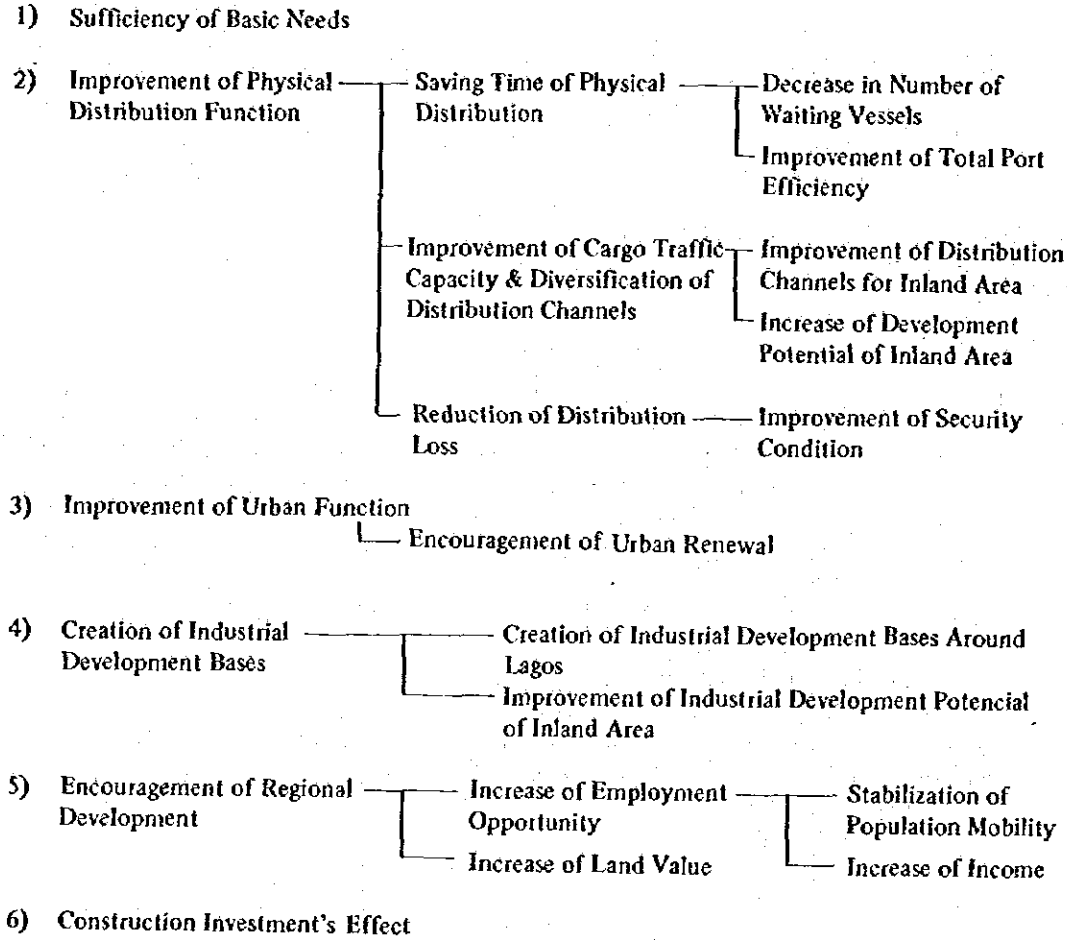
3 Roads in the First Stage are planned as two-lane.

4 The construction cost for roads in port area is included in the arterial transportation facilities.

13. Development Benefits of the New Ocean Terminal

13-1. Development benefits of the New Ocean Terminal

Table 13-1 Development Benefits of the New Ocean Terminal



13-2. Economic evaluation of the New Ocean Terminal.

Of the development effects of the New Ocean Terminal, described qualitatively in the previous section, those items which may roughly be evaluated economically within the rang possible at the stage of the Master Plan.

1) Value added with industrial production.

The value added created with industrial production located at the New Ocean Terminal may be regarded as economic effect of the development of the Terminal. The total annual value added arising from the industry expected to be located at the Terminal is estimated to be 1712 million dollars (₦1070 million). On the basis of the value added, the benefit from the construction of the New Ocean Terminal may be computed as below:

Benefit from the construction of the New Ocean Terminal through industrial production =

$$\text{Total annual value added} \times \frac{\text{the New Ocean Terminal construction costs}}{\text{Total construction costs including plant construction costs}}$$

$\times 20^{yrs} \times 1/2 = 1712 \times 4283/13763 \times 20 \times 1/2 = 5328$ million dollers = ₦3330 million

(2) Increase in utility value of land.

With the construction of the New Ocean Terminal the land which had hitherto very little utility value begins to acquire high utility value. Estimated price of land after the construction of the New Ocean Terminal may be taken as the land users' willingness to pay and the difference between the estimated price and the current land price may be regarded as the benefit.

Assuming that the estimated land price after the construction of the New Ocean Terminal is at the current level at Ikeja and that the usable land and around the Terminal may be sold or leased at that price, the benefit may be computed as below.

$7{,}500 \times 10^4 m^2 \times ₦10/m^2 = ₦750$ million (1978 prices)

It is to be noted that industrial land is excluded from the total land area in order to avoid duplication in the computation of the benefit.

(3) The above results may be compared with the construction costs of the New Ocean Terminal as shown in Table 13-2.

Table 13-2 Construction Cost and Benefit of the New Ocean Terminal

(Unit: million ₦)

Cost		Benefit	
New Ocean Terminal Construction Cost		Value Added with Industrial Production	3,330
		Land Price Rise	750
	2,677		4,080

14. Items for Further Survey

In a large scale project, such as the New Ocean Terminal, the master plan may be divided into several stages so that staged construction may occur as the port requirements grow.

In the case of the New Ocean Terminal, prior to each construction stage a short term (approximately 5 years) feasibility study is conducted so the scale of development can be studied in detail. The feasibility study is conducted to determine if the plan should actually be implemented, presupposing the final aim of the development shown in the master plan.

In order to implement the present project, it is necessary to conduct such a feasibility study following the Master Plan study described in this report. Those items for a feasibility study of a port and harbour project are given below.

a) Study of basic project policy
b) Demand forecast and determination of scale
c) Technical study
d) Analysis of development benefits
e) Financial analysis

The work flowchart for the above objectives of study is shown in Fig. 14-1.

Study works were completed at the master plan stage and to be done in the future may be determined as follows:

Items a) and b) were completed at the master plan stage.

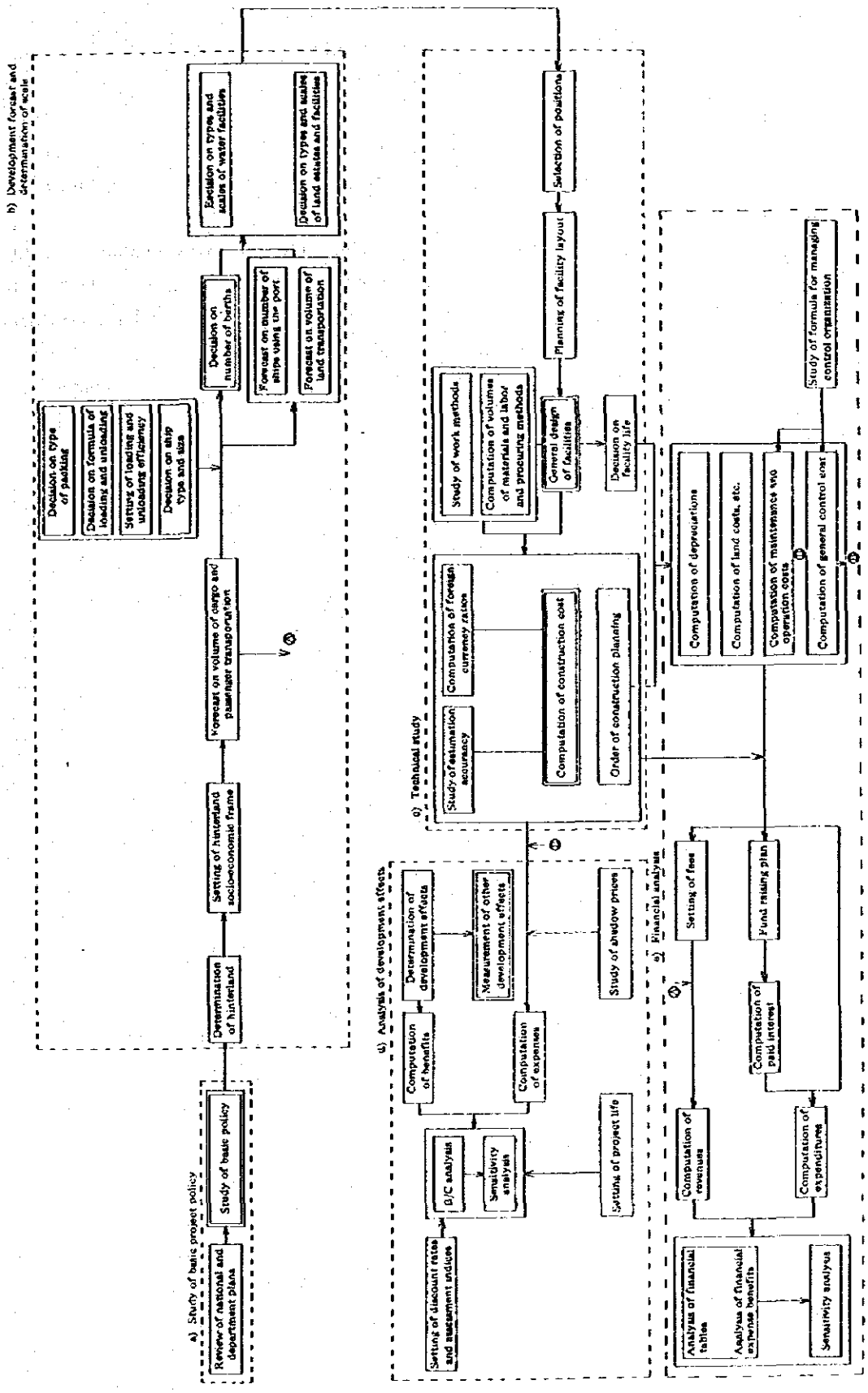
As to item c), the selection of the construction site and the planning of the layout of basic port facilities were completed at the master plan stage but the planning of the layout of related facilities, such as cargo handling equipment, storage facilities and utilities, the general design of facilities and the computation of the construction cost require a more detailed study.

Particularly, the general design of facilities and the computation of the construction cost must be sufficient to be used for d) analysis of development effects and e) financial analysis. It is, therefore, necessary for the investigation of natural conditions (which will provide basic data for design and computation) to be conducted in greater detail.

As to items d) and e), study at the master plan stage was made only of those development effects which could be quantitatively determined, to see macroeconomically if the New Ocean Terminal Project could benefit the national economy. So, these items must be exhaustively studied at the future stage of the feasibility study.

A large-scale development project, such as the New Ocean Terminal Project, must be planned not as a simple harbour facility construction project but as a regional development project centered around harbour development and covering the whole province of Lagos or covering many provinces. It is, therefore, necessary for related facilities (transport network plan etc.) to be studied and planned in coordination to the project at either the master plan stage or the feasibility study stage. This is not merely concerned with the planning of functional facilities but, of course, includes surveys on social effects and effects on natural environments.

Fig. 14-1 Flow Chart for Planning Work



The following are the principal items of survey and planning deemed necessary in connection with this investigation:

1) Construction of principal transport network facilities
2) Water development (fresh water and industrial water)
3) New City development plan
4) Survey and planning of coastal industrial sites
5) Survey on social effects and effects on natural environments and improvement proposals

If the above-mentioned investigation and planning related to this project are skilfully executed by the respective agencies of the concerned governments, maintaining project-wide conformity, and the overall propriety of the New Ocean Terminal Project is proved and confirmed as the result, the project will take a step toward its realization.

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I. Introduction

I. Introduction

I-1 Brief history of the study

In accordance with the agreement reached in October 1977 by the Japanese Government's Port Mission and the Nigerian Ports Authority, it was decided for the Government of Japan to conduct studies for the New Ocean Terminal Project in the Lagos metropolitan area.

The project was aimed at the next stage development of the Lagos Ports Complex after the completion of the Tin Can Island Port and the Third Apapa Extension.

The Government of Japan started the study in the fiscal year 1977 by sending a study team to Nigeria in January 1978. The main objectives of the study in the fiscal year 1977 were to select the most suitable location of a new port in the Lagos metropolitan area and to propose the scale of the port development with a long-term prospect.

Although the study on the site selection was not quantitative but qualitative a comparative study was made on possible sites; one is located in the vicinity of Tin Can Island Port, while another is situated approximately 50 km east of Lagos where a spacious virgin land is available for the development of a new port. Putting an emphasis on an orderly development of the Lagos metropolitan area which is so congested, in addition to some technical reasons we selected the latter site which has a wide variety of potentials for future development. Once a port is built the area around the port becomes very attractive to various types of seaboard industries. For this reason it was considered that the New Ocean Terminal should be planned so as to function not only as a mere commercial port but as a location of seaboard industries.

In view of the importance of a long-term planning the target year for the planning was set at the year 2000 and to determine the development scale of the New Ocean Terminal traffic forecasts were made on the total general cargo traffic through all the Nigerian ports. Then, the share to be borne by the Lagos Ports Complex, including the New Ocean Terminal, was calculated.

As to the suitable industries for location at the New Ocean Terminal, we selected several basic industries requiring their own water-front such as shipbuilding and repair yard, iron and steel mill, petroleum oil refining and petrochemical industry and flour mill, etc. which will play a vital role for the economic development of Nigeria.

The results of these studies were compiled to "Report on the New Ocean Terminal Project, Lagos (Phase-I)" in June 1978 by the Japan International Cooperation Agency and it was submitted to the Nigerian Ports Authority and government organizations concerned in July 1978.

The Nigerian Ports Authority agreed to the selection of the site 50 km east of Lagos and the contents of the Report were generally accepted by the NPA.

I-2 Purpose and scope of the study in the fiscal year 1978 and 1979

In accordance with the Scope of Work agreed upon by the two countries in 1978, three surveys were conducted in 1978: 1) survey concerning the master plan; 2) survey of topographic condition; and 3) geological survey.

The draft report of the Phase-II study, which was formulated on the basis of the results of the Phase-I Report in 1978 and the above surveys, was submitted to the Nigerian Ports Authority in July 1979.

In the fiscal year 1979, as the Phase-II (2nd year) study, survey of natural conditions at the proposed construction site was carried out. On the base of the survey, layout of breakwaters, calmness of the harbour and counter erosion measures etc. were reviewed. Also, forcasts of cargo traffic was modified. In January 1980, the final draft report of the Phase-II study was formulated and submitted to the Nigerian Ports Authority.

This is a final report of Phase-II study, was formulated on the review of the all items of the final draft report and some additional explanations.

The purpose of the master plan is to give a direction to the project from a wider perspective and to ascertain basic facts of the project such as the location and scale of the proposed New Ocean Terminal under long-term objectives. (Basic concept of the development of the New Ocean Terminal has been discussed in Phase-I Report)

Accordingly, the main items of the master plan study are related to comprehensive land use planning of the proposed development area, including general layout of port and harbour facilities such as breakwaters, channels, berths and wharfs which form the framework of the development project, layout of each seaboard industry and that of various urban facilities and transport facilities for trunk routes. They also include preliminary estimate of construction costs of basic facilities and qualitative study of the effects of the development.

As the scale and function of the proposed New Ocean Terminal is considerably large and comprehensive, it will have a wide range of influence on the socio-economic activities and ecological conditions of the surroundings.

The masterplan proposed in this report does not aim at the final conclusion for the New Ocean Terminal project and, as a matter of course, it cannot be said that the report covers all fields of the matter concerned completely.

It should be considered as a springboard for further discussions in order to make better decision.

II. Location of the New Ocean Terminal

II. Location of the New Ocean Terminal

Comparative studies on the site selection have been made in the Phase-I Report although those are not quantitative but qualitative. As a result the site situated 50km east to Lagos has been selected and the Nigerian Ports Authority has agreed to our selection and to conduct further studies on the proposed site in the fiscal year 1978.

However, opinions were heard, on several occasions when the Team visited Nigeria in November 1978, at the meetings with the Federal Ministry of Transport and Master Plan Project Unit of the Lagos State, that further development of Lagos State should be avoided from a viewpoint of national security or to curb more concentration to the Lagos Metropolitan area and that an alternative site should be selected with a study either to the entire Nigerian coast-line or to a place further east outside Lagos State. It appears to us that these opinions have overlooked the importance of port in the Lagos metropolitan area and of the metropolitan area itself.

Approximately 60 per cent of industrial outputs were generated in Lagos State in terms of value added in 1974. On the other hand it has been told that the population in the Lagos Metropolitan area will reach at least 13 million by the year 2000. The share of Lagos State will decrease in terms of industrial outputs in future as the development of other regions will be promoted as a result of the Federal Government's policy of industrial dispersal. In our view, however, the economic development of Lagos State cannot cease. An increasing population must be given employment opportunities and better living conditions. Without economic development of Lagos State how could these be realized? At least, it can be said that the economic development of Lagos State will continue at a lower rate than the national average if the federal policy of industrial dispersal is properly exercised. As far as the economic development continues and the population increase is inevitable, various types of infrastructures must be improved and expanded in order to attain an orderly development of the Metropolitan area. A commercial port is of a vital importance to the economic development. Is it economical to carry millions of tons of imported commodities from Onne port or Warri to Lagos area by road?

In our Phase-I Report the share to be borne by the Lagos Ports Complex in the year 2000 was reduced to 50 per cent from the present level of approximately 70 per cent in terms of general cargo traffic taking account of dispersal policies. According to the estimate of future traffic as shown in the Phase-I Report, a huge amount of traffic must be handled at the Lagos Ports Complex even if such a reduction of share is planned. And furthermore a considerable part of the traffic moves between the port and the Lagos Metropolitan area.

For these reasons it should be understood that the New Ocean Terminal Project is intended for the development of the Lagos Ports Complex and that the site of the New Ocean Terminal must be as close to the centre of the Lagos Metropolitan area as possible with a view to an orderly development of the metropolitan area on a long-term basis.

If the construction site is moved further east near the site we have proposed, as an alternative plan, it will be to the east of Lekki Lagoon, doubling the distance from Lagos compared with the site we have proposed. (See Fig. II-1) Further, we understand that there is a plan to construct a naval base to the east of Lekki Lagoon, and it has been pointed out that the selection of the site of the New Ocean Terminal which is to become a centre of Nigerian industries in future in the vicinity of a military installation will cause problems from the viewpoint of national security. Accordingly, it is not desirable to select such a site for the

Fig. II-1 Alternative Site for the New Ocean Terminal

construction of the New Ocean Terminal.

The importance of industrial development in the vicinity of the Lagos metropolitan area was already described in the Phase-I Report. In case that an industrially less developed nation is going to promote economic development by introducing modern industries, the utmost importance must be placed on offering an attractive site to industries. The nearness to Lagos, the largest domestic market and the existence of a modern seaport are decisively advantageous conditions to industrial locations. It appears to us that at the beginning stage of economic development it is extremely important to develop first the most effective area to the entire economy of a nation.

In order to clarify the approach to the selection of the construction site mentioned in the Phase-I Report and the justification of the selection of the site for the New Ocean Terminal which has so far been given, overall comparison of three alternative sites, e.g., Site-A (close to the west side of the present Port of Lagos), Site-B (50km east of Lagos) and Site-C (further to the east of Site-B) will be made below from the viewpoint of the suitability for meeting the basic needs of Nigeria (See Table II-1).

Table II-1 shows some of the basic needs of Nigeria which may be met with large scale port and harbour development and basic tasks required for that purpose.

Expansion of the physical distribution function in Nigeria and the Lagos Metropolitan area is undoubtedly of an urgent need at a national level and may be regarded as the most basic need of the country in view of the present situation at the Port of Lagos and the future demand for distribution.

Table II-1 Evaluation Factors of the Alternatives

Basic needs	Tasks to meet the basic needs
1) Expansion of physical distribution function in Nigeria and the Lagos Metropolitan area.	1) Development of a modern commercial port in the environs of Lagos having the same functions as those of the present Port of Lagos.
2) Development of Nigerian industry.	2) Creation of the basis of industrial development.
3) Sound development of the Lagos Metropolitan area.	3) Dispersion of population and urban functions.

Needless to say, Lagos is the political and economic centre of Nigeria, and it may be justified to say that all functions are concentrated in the Metropolitan area. If the present Port of Lagos has already reached the marginal point for expansion and if further expansion of the Port of Lagos is undesirable from the viewpoint of preventing over congestion in the Metropolitan area, the new port to supplement the present one should have functions similar to those of the Port of Lagos and be located as close as possible to the Port of Lagos.

In order to raise the standard of living in Nigeria, it is indispensable to improve industrial structure. It will thus be necessary to consolidate the foundation of agriculture and industrialization for future development. Though there are signs of industrial orientation in Nigeria, it's level is still low, and it will be necessary to expand further the basic industries for full scale industrialization.

The Lagos Metropolitan area is the heart of Nigeria, and without its sound development the development of the country as a whole is inconceivable. Since the Metropolitan area is already congested due to concentration of population, it will be necessary to disperse the population concentrating in the Metropolitan area and urban functions catering for the increasing population to meet the future population increase.

We have so far touched upon the basic needs of Nigeria and tasks to meet them. Table II-2 gives qualitative evaluation of the suitability of each site for carrying out the tasks.

As for Task (1), it is possible to integrate Site-A and the present port in use and administration. The site also has an advantage of making use of the existing infrastructures of the

Table II-2 Evaluation of the Alternative Sites

	Tasks to meet the basic needs		
Site	1) Development of a modern commercial port in the environs of Lagos having the same functions as those of the present Port of Lagos.	2) Creation of the basis of industrial development.	3) Dispersion of population and urban functions.
Site–A	Δ	Δ	X
Site–B	O	O	O
Site–C	X	O	O

Remarks: O Suitable
Δ Not impossible, but technical difficulties.
X Unsuitable

hinterland. However, there is a technical problem of constructing a new harbour entrance.

Site-B is at a distance of 50km from the present port. However, such a distance is not detrimental for serving the Lagos Metropolitan area; in fact it may be the distance which makes it possible for the two ports to share functions according to their characteristics by improving transport facilities of the hinterland.

Several cases of the dispersion of harbour functions may be found in other countries. In none of them, however, dispersion at a great distance from existing facilities seems to be found. In the case of New York, for instance, the new Elizabeth Port with modern container wharfs was constructed on the New Jersey side at a site nearly 20km from Manhattan with its commercial and infomation functions and port functions which have developed over a long period of time.

In France, an industrial port is being planned at Fos, about 45km from Marseille, and commercial functions are also expected to be developed. In the case of Japan, the Port of Tokyo and Yokohama are about 25km apart, supplementing each other as an integrated marine terminals.

These cases invariably show that port functions developed at two points with a considerable distance between them are performing integrated functions through a close link formed by land

transport in the hinterland. The point which is common to all of them is that those port functions developed first and urban accumulation are used as a drive for the development of a new port. In the case of New York, since a suitable site was available at Elizabeth area, part of the conventional wharfs for general cargo in Manhattan, the centre of the city, is already being abandoned to be used as the place for the renovation of urban functions.

It is desirable that a new port is developed at the site which will not hinder long-term orderly development of the Metropolitan area and which is as close as possible to urban accumulation. Quantitatively speaking it is a distance which may be covered by car in one to two hours. In other words, business trip on a half-day basis should be possible. Such a distance will make it possible for the new site and the old site to share functions. It will also make it possible for the old accumulation to be moved to the new site.

In this sense, Site-C is clearly less advantageous than Site-B. Development suitable for Site-C should be carried out at the next stage of development when the development of the Metropolitan area and its environs has reached the marginal point of development. Furthermore, in this case, industrial development should be prior to commercial port functions. The pattern of development is that urban formation proceeds first with industrial functions as its nucleus followed by gradual provision of commercial port functions. Thus, it is clear that Site-C is not advantageous for the provision of commercial port functions which will be required by Nigeria within the next twenty years.

With regard to the creation of industrial base as has already been mentioned in the Phase-I Report, Site-A can provide only a limited area of land for development as it is close to the existing urban area, and is, therefore, not suitable for large scale industrial development centring around a port. Of course small scale industrial development is not impossible even at Site-A. However, from a long-term point of view, small scale industrial development will not compete on the world market unless it is of a considerable scale. Therefore, development of small scale seaboard industries at Site-A even at the risk of increasing congestion in Lagos can not be justified for the future of Nigeria.

In this respect, Site-B is provided with spacious virgin land and can be easily provided with the transportation system to inland areas. Further, it is close to a centre of consumption and the subsoil condition offers no problems for construction. Another advantage is that if commercial port functions are developed at Site-B, the location as a centre of distribution can be fully utilized for industrial location.

As for Site-C, as has already been mentioned, it will be unrealistic to provide commercial port functions at the site without any link with the existing urban accumulation; it will rather be more suitable for waterfront industrial development. Further, though Site-C is provided with ample land area which can be utilized for industrial development as Site-B, it is more disadvantageous than Site-B from the viewpoint of providing the transportation system to inland areas.

With regard to the dispersal of population and urban functions, Site-A is clearly too close to the area with already concentrated population and has the disadvantage of increasing congestion in the urban area. In this respect, Site-B and Site-C will not add any additional population load to the centre of Lagos as they are at a considerable distance from the city.

From the viewpoint of dispersal, there is an argument against Site-B that it is still within the environs of Lagos and will not, therefore, result in population dispersal on the national level. However, if the policy of population dispersal is discussed in a national perspective, it should be dealt with by an entirely different project.

The role to be played by the development of the New Ocean Terminal in the environs of Lagos is to disperse the existing population of the city, which is becoming increasingly congested, within a realistic range as soon as possible. Those people moving to Lagos are seeking employment opportunities offered by the Metropolis. Accordingly, in view of the present situation in Nigeria, even if the foundation of a new city has been laid at a remote distance from Lagos, population of that nature will not easily flow into the new city and, therefore, concentration of population attracted by the present City of Lagos will continue.

If the New Ocean Terminal is located at Site-B, it will still be in a position to enjoy urban attractions of Lagos and yet at a sufficient distance from the existing accumulation area of Lagos.

In conclusion, after evaluating the suitability of three alternative sites from various viewpoints, Site-B is, in our opinion, the most suitable site in view of the present situation in Nigeria and topographic and other conditions.

III. Basic concept for the layout of various functions of the New Ocean Terminal and the scale of development

III. Basic Concept for the Layout of Various Functions of the New Ocean Terminal and the Scale of Development

III-1. Principles for the formulation of the master plan

The master plan for the New Ocean Terminal is to be formulated according to the basic policy described below.

1) In view of the topographic and natural conditions of the construction site of the New Ocean Terminal, port facilities are to be positioned along excavated channels. In other words, as a basic type, an artificially excavated port is to be selected for the New Ocean Terminal. Further, in order to provide various functions required by the terminal, the port is to have one harbour entrance, and three channels branching off from there.

2) The development of the industrial area is not particularly aimed at the completion in the year 2000; it is more for the provision of space for future location of industries.

The progress of industrial location depends on the policy for industrialization to be taken by the Federal Government, and it may not coincide with the progress in the development of the commercial port. Therefore, various functions are to be positioned in a way that the development of the commercial port can proceed independently of industrial development. That is, most of the commercial port facilities are to be placed to the west of the main channel and the industrial area to the east.

3) Facilities are to be located in such a way that the development of commercial and industrial port facilities may proceed under stage planning.

4) In view of the predominant wind direction, urban facilities are to be placed in the north of the commercial port area.

5) The arterial road is to run north from the development area to reach the existing road between Epe and Ikorodu via bridge on the channel linking the Lagos Lagoon and the Lekki Lagoon.

The New City, commercial port area and industrial area are to be linked by arterial roads running through the development area.

6) The new railway line is to be planned basically in the same way as the arterial roads. The time of its construction is, however, to be determined taking account of the time of implementation of the standard gauge project now under study by the Nigerian National Railways.

7) Judging from the data obtained so far, predominant waves are expected to be from SW direction. The main breakwater is, therefore, to be placed to protect the channel and the harbour basin from these waves.

8) As the annual total of incoming vessels is expected to be around 6,000 to 7,000 (average, 17-20 vessels per day), on the final stage of the project with the completion of various plans including industrial development, the port is to adopt the one harbour entrance system.

9) The length of the main breakwater is to be determined so as to ensure safe navigation of the largest ship and calmness of the harbour basin. However, it is to be reexamined from the

viewpoint of preventing silting of the channel due to littoral drift based on the results of coastal engineering survey in 1979.

10) The width of the entrance channel and the inner harbour channels is to be determined so as to ensure two way traffic as a rule.

11) Space for future expansion of commercial port facilities is to be provided at the end of West North and East Channels.

III-2. Alternative plans for the layout of functions.

If a long breakwater is allowed to protrude from the sandy shore on a straight line since the littoral current is predominant from west to east, the west side shore of the breakwater is expected to move forward and some part of east side of it may recede as seen near the harbour entrance of Lagos.

Accordingly, an opinion may be heard that it is desirable to place the commercial port area to the east of the main channel and the industrial port area to the west. However, we did not adopt this alternative plan because of the reasons given below.

1) As has been mentioned, the development of the commercial port area is expected to precede industrial development. Therefore, it is desirable that the New City and the commercial port area are adjacent to each other.

2) Several villages along the coast will be compelled to move by the developmen of the industrial area. In that case, it is desirable that they move to the coast under aggrandizing condition (west coast) rather than to the one under eroding condition. It will also have the advantage of being nearer to the New City.

3) With the construction of the breakwater, it is conceivable that the coast to the east recedes. However, it is expected that the erosion occurs near the east end of the proposed industrial land or even further to the east. Further, even if the coast fronting the industrial land suffers from erosion, adequate prevention will be possible with the construction of the groin systems and others.

III-3. Alternative plans for the layout of channels and mooring basins.

The one harbour entrance system proposed under the master plan has demerits such as 1) traffic capacity of the entrance section restricts the expansion of the scale of the whole and 2) shipping accident may block the entrance and the port may, as a result, stop functioning.

However, the present project is an extremely long-term plan looking ahead into the future more than 20 years from now, and it is not necessary to consider further development at the same site. For industrial development, for instance, the scale of iron and steel and oil refinery, which form the nucleus, is designed at a standard which compares favorably with the international standard. Further, it is not necessary to carry out further expansion at one and the same site; industrialization in many other areas will in fact be more effective for regional development.

As for the prevention of shipping accidents, it will be possible to reduce the probability greatly by adopting a navigation control system employing electronic equipment and devices.

Accordingly, though the alternative plan of providing two harbour entrances was studied, it was decided not to adopt the plan as the costs of breakwaters, dredging of channels and excavation would increase.

III-4. The master plan and the scale of development.

Figs. III-1; III-2 and Tables III-1; III-2 show the master plan formulated under the above principles and various studies described in the following sections.

Table III-1(a) Distribution of Land Use in the Development Area

Unit: ha

	1990		2000	
		(%)		(%)
Port & Harbour Area (Land)	293	1	973	5
(Water)	195	1	927	5
Industrial Area	0	0	2,340	12
New City Area	100	1	2,900	14
Arterial Transportation Facility Sites	114	1	225	1
Sub Total	702	4	7,365	37
Reserved Area for Expansion	12,323	61	5,660	28
Unurbanized Area*	7,115	35	7,115	35
Sub Total	19,438	96	12,775	63
Total	20,140	100	20,140	100

Note: * This area includes inland water surface of Omu Creek and Lagos Lagoon.

Table III-1 (b) Port and Harbour Area

Unit: ha

	1990		2000	
		(%)		(%)
Wharf				
Break Bulk (General Cargo) Berths	22	7	122	13
Container Berths	72	25	324	33
Grain Berth	9	3	9	1
Petroleum Oil Berths	35	12	90	9
Small Craft Berths	2	1	3	0
Wharf Total	140	48	548	56
Port Related Commerce & Business	56	19	230	24
Port Roads	57	19	155	16
Other Related Facilities	40	14	40	4
Land Area Total	293	100	973	100
Channel				
Entrance Channel	19	10	196	21
Central Channel	56	29	96	10
West Channel	63	32	152	16
East Channel	–	–	168	18
North Channel	–	–	108	12
Channel Total	138	71	720	77
Water Surface for Basin and so forth	57	29	207	23
Water Area Total	195	100	927	100

Table III-1 (c) Industrial Area

Unit: ha

	1990		2000	
Iron and Steel	–	– (%)	700	30 (%)
Petroleum refining	–	–	300	13
Petrochemicals	–	–	210	9
Chemical Fertilizer	–	–	15	1
Automobile Assembly	–	–	120	5
Shipbuilding & Repair	–	–	45	2
Flour Mill & Food Processing	–	–	15	1
Vegetable Oil	–	–	5	0
Power Station*	–	–	–	–
Other Related Industries	–	–	380	16
Public Facilities	–	–	550	23
Total	–	–	2,340	100

Note: * Power station (40 ha) is planned in the commercial port area.

Table III-1 (d) New City Area

Unit: ha

	1990		2000	
		(%)		(%)
Residential Area	50	50	1,450	50
Commerce & Office	4	4	120	4
Public Facilities	6	6	170	6
Roads	20	20	580	20
Open Space	20	20	580	20
Total	100	100	2,900	100

Table III-2 Comprehensive Development Frame of the New Ocean Terminal

	1990			2000		
PORT DEVELOPMENT	Cargo Traffic (1,000 ton/yr.)	Berths (No.)		Cargo Traffic (1,000 ton/yr.)	Berths (No.)	
Commercial Port						
Break Bulk General Cargo Berths	1,207	6		6,606	33	
Container Berths	3,006	6		13,414	27	
Grain Berth	964	1		1,042	1	
Petroleum oil Berths	2,100	2		5,400	3	
Small Craft Berths	–	Total length 300 m		–	Total length 1,100 m	
Total	7,277	15	Employees: 2,000 persons, Total Length of: 4,450 m Breakwaters	26,462	64	Employees: 10,000 persons, Total Length of: 5,150 m Breakwaters
Industrial Port						
Iron & Steel Berths	–	–		*(12,900 1,620	(4 9	
Petroleum Oil Berths	–	–		*(18,850 7,160	(2 1	
Petrochemical Berths	–	–		*(150 965	(1 5	
Shipbuilding & repair Berths	–	–		–	3	
Grain Berths	–	–		*(750 0	(1 0	
Total	–	–		42,395	26	

INDUSTRIAL DEVELOPMENT	Production Scale	Employees (person)	Production Scale	Employees (person)
Iron and Steel	–	–	(crude steel) 6 million tons/yr.	10,000
Petroleum refining	–	–	400,000 barrels/day	1,200
Petrochemicals	–	–	(ethylene basis) 400,000 tons/yr.	2,350
Chemical Fertilizer	–	–	500,000 tons/yr.	200
Automobile Assembly	–	–	200,000 vehicles/yr.	5,000
Shipbuilding & repair	–	–	200,000 G.T. dock	1,000
Flour mill & Food Processing	–	–	500,000 tons/yr.	1,800
Vegetable oil	–	–	250,000 tons/yr.	200
Power Station	500,000 KW	150	1 million KW	250
Other Related Industries	–	–	–	8,000
Total	–	150	–	30,000

NEW CITY DEVELOPMENT	Population (person)	Housing (unit)	Population (person)	Housing (unit)
	7,500	1,500	200,000	40,000

Note: * Upper figures show raw materials, lower figures show products.

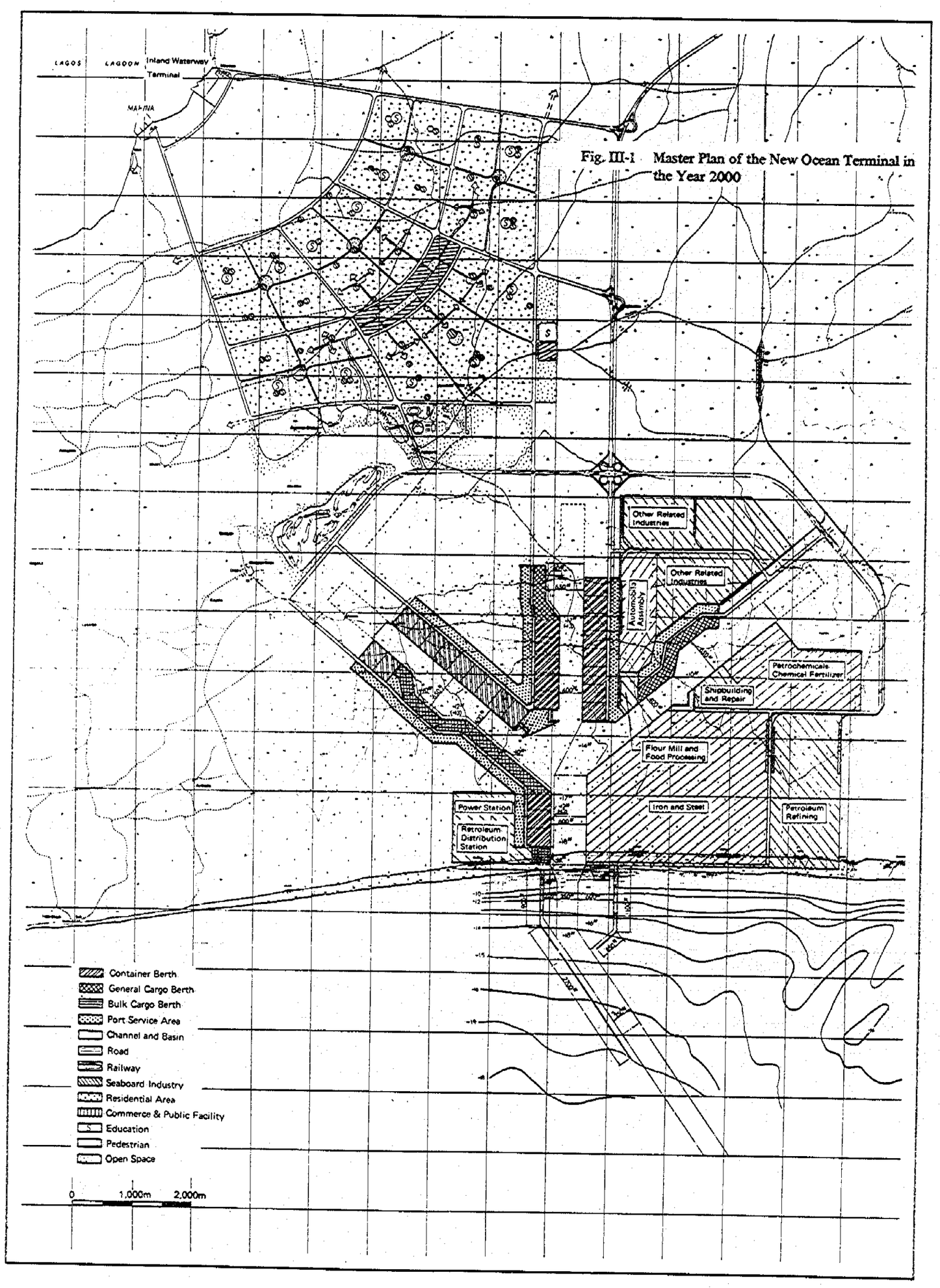

Fig. III-1 Master Plan of the New Ocean Terminal in the Year 2000

Fig. III-2 Generalized Land Use Plan in the Development Area